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7.1 International Council for Science (ICSU)

7.1.1 International Geosphere-Biosphere Programme (IGBP)

Fennel



International Geosphere-Biosphere Programme: an update

IGBP Secretariat, July 2011

The collaboration between IGBP and SCOR has been strong for two decades. Current joint activities include co-sponsorship of the major international research projects IMBER and SOLAS, Fast Track Initiative on Open Ocean Nutrient Limitation and Megacities in the Coastal Zone, and the Third Symposium on the Ocean in a High-CO₂ World planned for 2012. In this short report, we provide some recent updates of IGBP science and direction.

IGBP vision and ICSU's Earth-system science visioning process

IGBP updated its strategic vision after a wide-ranging consultation with its community. This update reflects the changing landscape of global-change research, particularly the increased emphasis on transdisciplinarity, policy relevance and communication. IGBP continued to engage actively in ICSU's visioning process leading to a new initiative on Earth system research for global sustainability. In March IGBP appointed an ad hoc committee of the IGBP SC to provide input to the ICSU process.

James Syvitski to chair IGBP beginning January 2012

Professor James P M Syvitski was appointed recently as the next chairperson of IGBP. He will assume his responsibilities on 1 January 2012, and will succeed Professor Carlos Nobre. The IGBP Chair leads the Scientific Committee, IGBP's main decision-making body. The US academic is Executive Director of the Community Surface Dynamics Modeling System and Professor at the University of Colorado. He brings extensive experience directing large national and international research institutes and programmes. Syvitski specialises in research on rivers, deltas, polar environments, sediment transport and continental margins. He was invited to attend and contribute to IGBP's SC meeting this year.

IGBP's second synthesis

In 2009, IGBP decided to begin synthesising available knowledge about several policy-relevant topics with a view to providing a snapshot of the state of the planet. This is a truly transdisciplinary activity, between research scientists, industry and the policy community. Outcomes of the second synthesis will include peer-reviewed papers, commentaries and summaries for policymakers, and are expected to feed into the Planet Under Pressure conference and international assessments including the IPCC Fifth Assessment Report. The past year

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witnessed several workshops relating to the synthesis, including the needs of least developed countries, ecosystem impacts of geoengineering, nitrogen and climate, air pollution and climate, and megacities in the coastal zone. The workshops have yielded reports that have been/will be submitted for publication in peer-reviewed journals. These are also being made available to various IPCC meetings.

Planet Under Pressure Conference, 26-29 March 2012, London

The 2012 international Planet Under Pressure conference will provide a comprehensive update of the pressure planet Earth is now under. The conference will discuss solutions at all scales to move societies on to a sustainable pathway. It will provide scientific leadership towards the 2012 UN Conference on Sustainable Development - Rio+20.

Drawing on our knowledge about the past, the present and future, the conference will focus attention on the latest research in climate science, ecosystem services, land use, biodiversity loss, planetary thresholds, and food, water and energy security. It will also announce a new contract between science and society through the launch of the ICSU initiative on Earth System Science for Global Sustainability.

The conference is co-sponsored by ICSU's four global change programmes, IGBP, IHDP, DIVERSITAS and WCRP and their Earth System Science Partnership.

www.planetunderpressure2012.net



Update on ocean observations – a common vision

Having participated in the Ocean Obs '09 conference in Venice, IGBP has provided inputs to a framework for global sustained ocean observations in the coming decade. The framework report is being led by the Intergovernmental Oceanographic Commission (IOC). A draft vision arising from this activity has been circulated to various programmes and organisations for their input, and is expected to be finalized during 2011.

Global Change continues to inform

Launched in December 2009, IGBP's biannual *Global Change* magazine (<http://www.igbp.net/page.php?pid=231>) has received overwhelmingly positive feedback from the wider IGBP community and beyond. Issues produced during the past year have featured a wide range of content, including interviews with Elinor Ostrom (winner of the 2009 Nobel Prize in economics) and Janos Pasztor (Chief Climate Advisor to UN Secretary-General Ban Ki-moon), and features on ocean acidification, South American and European palaeoclimate, and emissions scenarios. The magazine provides a single forum to highlight the diverse research conducted by its core projects and opinion pieces on key global change issues.

Upper Ocean Nutrient Limitation: processes, patterns and potential for change

Studies conducted during the past few decades have demonstrated that the productivity of the upper oceans is limited by the availability of a range of nutrients including nitrogen, iron and phosphorus. However, several aspects remain to be fully understood, for example, the nutrients that limit nitrogen fixation in the modern oceans and the role of trace elements other than iron. The term “limitation” itself has several definitions, resulting in confusion and hindering effective communication between researchers in different disciplines. With this in mind, this IGBP-SCOR fast-track initiative surveyed our current understanding of nutrient limitation in the upper oceans, identified gaps in knowledge and evaluated methodologies used to assess nutrient limitation. Potentially limiting nutrients such as macronutrients like nitrogen, micronutrients (e.g. iron) and organic nutrients (e.g. vitamin B12) were considered. A workshop was held in November 2010 in the UK and a number of papers are in preparation.

Megacities in the coastal Zone

This IGBP/SCOR fast track initiative held a workshop in Norwich in April 2010 and a synthesis paper is in preparation. It focuses on the physical and biogeochemical interactions between the atmosphere, the land and the ocean in and around coastal megacities. These relate to air and water quality as well as regional climate and hence directly affect human wellbeing. Costanza et al (1997) estimated the monetary value of the coastal zone as an ecosystem and service provider to be US\$12 trillion, which also highlights the economic importance of the detrimental effect of coastal megacities on the coastal zone. There are a number of important feedbacks arising from air-sea interactions that have so far been neglected.

The FTI identified what they believe to be the most important environmental issues as: Effects on the self-cleansing capability of the atmosphere (in the megacity and its outflow); Greenhouse gases: sources, atmospheric lifetime; Pollution and health; Coastal eutrophication and resulting effects including on fisheries; Atmospheric circulation/mixing; Hydrological cycle; Radiative forcing caused by the MCCZ. They suggested ways to manage megacities to minimise their immediate and global impacts

The Ocean in a High CO₂ World – Third Symposium

Following the successes of two previous symposia on ocean acidification (Paris, 2004 and Monaco, 2008), the SCOR, IGBP and IOC are planning a third symposium on The Ocean in a High-CO₂ World, to take place in Monterey, USA, 24-27 September, 2012. The three-day symposium will focus on ocean acidification and its impacts on marine organisms, ecosystems and biogeochemical cycles. It will also cover socio-economic consequences of ocean acidification, including policy and management implications.

www.highCO2-iii.org

Integrated Observing Strategy

Under development by the AIMES project, the strategy commissioned by IGBP focuses on integrating observations of the physical, biogeochemical and human dimensions of global change. Existing observing networks are not designed to do this and instead focus on discrete tasks within individual domains or disciplines. The group developing the strategy mentions that a

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more integrated observing system approach is needed to detect and understand complex environmental system responses to change. For example, an integrative understanding of water supply, demand and recycling requires natural observations that capture physical and biophysical aspects of hydrology. But it also needs to include information on water-resource demands, engineering and policy aspects. An ongoing need is to integrate space-based observations with in situ observations: this is challenging because the temporal and spatial scales of space-based observations differ considerably from those of observations on the ground. According to the group's preliminary assessment, there has been an underinvestment in measurements in the following areas: tropical regions, high altitudes, the remote ocean and areas intensively affected by human activity.

Report on role of black carbon in climate

An assessment of black carbon's role in climate is expected to be published in late 2011. The assessment was led by IGBP's Global Atmospheric Chemistry project (IGAC) (International Project Office: Seattle) and the World Climate Research Programme's SPARC project (Stratospheric processes and their role in climate). The assessment will be important for the IPCC Fifth Assessment Report and the United Nations Environment Programme.

7.1.2 World Climate Research Programme (WCRP)

MacCracken

World Climate Research Programme (WCRP):
Report to 2011 SCOR Executive Committee Meeting
(12-15 September 2011, Helsinki, Finland)

This report provides a brief summary of main ocean-related WCRP activities since the time of the previous SCOR Executive Committee in Beijing, China, in October 2009. Since then WCRP has continued active support to and promotion of global coordination and integration of climate research sponsoring ~60 conferences, workshops, meetings and symposia focused on all aspects of the Earth's climate system (i.e. oceans, atmosphere, cryosphere and land-surface).

More information on WCRP activities including its activities linked to oceanography is available from the WCRP and CLIVAR websites (<http://wcrp.wmo.int> and <http://www.clivar.org>).

Joint activities of WCRP and SCOR

The

- SCOR/WCRP/IAPSO WG 136 “Climatic Importance of the Greater Agulhas System”,
- IGBP/SCOR/WCRP/CACGP Surface Ocean-Lower Atmosphere Study (SOLAS), and
- Southern Ocean Observing System

are at the moment jointly sponsored by WCRP and SCOR. These activities will be individually reviewed by the SCOR Executive Committee.

Planning and implementing the WCRP activities

The central focus of the “Coordinated Observations and Prediction of the Earth System (COPES, see http://www.wcrp-climate.org/documents/WCRP_IP_2010_2015.pdf)”, the WCRP Strategic Framework for the years 2005-2015, is to translate achievements in fundamental understanding of climate processes contributing to the variability and change in global and regional climate into a range of information products such as seasonal, regional and decadal climate predictions, projections and assessments of high societal value for a broad range of applications and users.

The Programme Implementation Plan for the interim period (up to 2015, with a focus on completing the tasks formulated in the Strategic Framework) was completed and published in September 2009 (WCRP 2009, WMO/TD-No. 1503, http://www.wcrp-climate.org/documents/WCRP_IP_2010_2015.pdf). The Plan addresses priorities identified in the ICSU/WMO/IOC/IGFA independent review of WCRP and outlines how WCRP would deliver the best available state of knowledge on climate variability and change to the decision-makers, in an unbiased, policy relevant but not policy prescriptive manner consistent with the challenges and opportunities associated with prediction of weather and climate across all time and space scales. The Plan describes how WCRP would focus its activities and partnerships on fulfilling the existing and

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emerging societal needs. In addition to the Implementation Plan, WCRP assembled a report highlighting its main achievements since the initiation of COPEs. A forward-looking strategy beyond 2015 is being developed based on an assessment of the future scientific priorities and requirements of the WCRP sponsors and the international science community.

WCRP continues to bring together scientists from around the world to formulate new research agenda and to leverage scientific know-how between researchers and across disciplines and between developed and developing countries. Ocean research in relation to climate remains very high on the WCRP science agenda. WCRP pursues its research objectives through observations, process-understanding research, modelling and analysis, with an emphasis on practical results of regional and global importance.

WCRP ocean and climate research including observations, modeling and prediction

Most WCRP projects are involved in aspects of oceanographic research. CLIVAR provides the focus within WCRP on understanding the role of the oceans in climate, develops observing systems, promotes reanalysis of existing ocean data, and develops ocean modules of global climate models. CliC contributes to these activities on cryospheric and polar aspects. GEWEX does so in the areas of surface flux research. As a co-sponsor of the Ocean Observations Panel for Climate (OOPC), WCRP strives to ensure high-quality and long-term ocean observations for climate and oceanographic research and prediction.

WCRP, together with IGBP, SCOR and the international Commission on Atmospheric Chemistry and Global Pollution (CACGP) continues to sponsor the Surface Ocean-Lower Atmosphere Study (SOLAS).

Climate model development and prediction experiments

WCRP is actively spearheading the improvement of climate predictions and projections. The WCRP Climate Model Intercomparison Project (CMIP5) coordinated by the WCRP JSC / CLIVAR Working Group on Coupled Modelling provides the framework for climate change modelling research and the basis for the next IPCC Assessment (AR5). As part of the CMIP5, WCRP is exploring the potential of decadal predictions that can provide useful information for developing adaptation strategies. Over 20 groups and about 40 models are participating in CMIP5. A data submission procedure is in place to publish CMIP5 data to the Earth System Grid (ESG) including multiple quality control tests. A CMIP5 analysis workshop is being planned for spring of 2012. The CMIP5 archive has started receiving model output and serving to users. More than 2 Petabytes of data are expected to be available for users, about 100 times more data than was produced for CMIP3 that served as the basis for the IPCC Fourth Assessment Report (AR4) in 2007. Coordinated use of CMIP5 climate projections and predictions for ocean research and coastal zone management applications is encouraged. As an example of facilitating a well-thought through use of the CMIP5 archive, WCRP and WMO/IOC JCOMM held on 11-13 April 2011 in Geneva, Switzerland, a workshop on Coordinated Ocean Wave Climate Projections (COWCLIP).

WCRP's efforts to improve regional climate projections and predictions are organized through a coordinated regional climate downscaling experiment (CORDEX) that is producing regional climate

projections for many areas of the world with an initial focus on Africa. A team of regional scientists evaluate the strengths and limitations of the regional climate model results that will be used for a range of climate adaptation and risk management practices. WCRP regional activities also cover the ocean-atmosphere-land interactions of monsoonal nature, which are coordinated through the Asian-Australian Monsoon Panel (AAMP), Variability of the American Monsoon Systems (VAMOS), and Variability of the African Climate System (VACS) project. A major effort similar to CMIP5 is underway to promote the use of CORDEX results in a wide range of applications at the regional level in such areas as water resources, food production, ecosystems management, etc.

WCRP is examining in depth the capabilities and limitations of current generation of climate models that represent the major components of the Earth system, including the oceans, and their interactions. A community-wide consultation on the model evaluation and improvement involves a survey that was developed and circulated in 2009. Over 100 independent responses were received. The results are currently being analyzed to evaluate and document the model uncertainties. The resultant analysis will be published in the open literature, and a workshop will be held in 2012 to define the major areas of research for model development/improvement based on the survey results, and to draw up an implementation plan with active engagement of international community to address them. The CLIVAR SSG has formed a Task Force to explore how CLIVAR can best contribute to improving components of Earth system models.

Ocean model development and prediction experiments

The Working Group on Ocean Model Development (WGOMD) is developing the Coordinated Ocean - ice Reference Experiments (CORE), particularly the CORE II protocol. There are plans for coordinated analysis, as well as the status and developments of the CORE InterAnnual Forcing (IAF) dataset and the Repository for Evaluating Ocean Simulations (REOS). The analysis will be relevant for the evaluation of the ocean component of CMIP5 participating models as well as for the initialization of decadal predictions. It will cover time mean diagnostics over 1988-2007 and variability defined with respect to this mean, trends and changes over this period. Regional case studies such as one on changes in the strength of the Atlantic sub-polar gyre will contribute to understanding of observed variability. The CORE II simulations can also explore sensitivity of the ocean to changes in precipitation at high latitudes, in zonal wind trend over the Southern Ocean and to abrupt shifts in the buoyancy and mechanical forcing. WGOMD will produce CORE II synthesis papers within the timeframe for evaluation by IPCC AR5. A Workshop “Decadal Variability, Predictability and Prediction: Understanding the role of the Ocean”, held on 20 - 23 September 2010 in Boulder, USA, discussed prospects for the broader community to develop a common framework for research in decadal variability, predictability and prediction including the role of the ocean observations and modeling. At its most recent meeting, the CLIVAR SSG formed a Task Force to identify and coordinate decadal variability and predictability activities across all its panels and working groups.

OceanObs'09 and sustained ocean observations

WCRP was a co-Sponsor, active participant and supporter of OceanObs'09 (Venice, 25-29 September 2009) organized by the IOC and European Space Agency (ESA). Chairs of the OOPC and CLIVAR Global Synthesis and Observations Panel were the Co-chairs of the Symposium. The

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resulting report on Integrated Framework for Sustained Ocean Observations will guide WCRP contribution to the development of sustained ocean observations.

A Workshop “XBT Bias and Fall Rate” was held on 25-27 August 2010 in Hamburg, Germany. It made recommendations for future work on reducing biases in both historical and future XBT data sets.

GO-SHIP

The IOC-SCOR International Ocean Carbon Coordination Programme / CLIVAR Global Ocean Ship based Hydrographic Investigations Programme (GO-SHIP) held an international planning meeting on 21 February 2011, in Portland, Oregon, USA. The GO-SHIP committee published a Community White Paper developed for the OceanObs’09 Conference as a strategy document. The committee has now finalized the GO-SHIP Development Plan, which outlines priorities and timelines for coordinating national hydrography programs into a global coordinated network, and the organizational framework and budget required to develop a sustained program. The Plan will be published soon. GO-SHIP has also published the Repeat Hydrography Manual (<http://www.goship.org>).

Global Synthesis and Observations, Reanalysis

A variety of reanalysis and data synthesis activities are underway for the atmosphere and ocean. Products of global reanalysis have provided the basis for advances in many areas, including climate now-casting and diagnostic studies of complex systems such as monsoons or the El Niño-Southern Oscillation. Global reanalysis is also the foundation for regional reanalysis projects and downscaling to study local climate and climate impacts. In addition, the development of comprehensive Earth system models requires expanding the scope of reanalysis and conduct of coupled atmosphere-ocean data assimilation. As the science of reanalysis grows, there is an urgent need to align financial and infrastructural resources for data handling and processing and to foster sustained international cooperation. The WCRP-GCOS co-sponsored Observation and Assimilation Panel (WOAP) is embarking on an inventory of WCRP data sets to facilitate access and assist in model validation and verification. USA hosted a series of workshops to: (1) review the current status of reanalyses and the lessons learned from them, and (2) identify the primary technical issues (from assimilation system and observation perspectives) that need to be addressed in the next reanalyses as well as new reanalysis systems (CFSR, 20thC, and MERRA), observations, and integrated Earth system analysis. The CLIVAR Global Synthesis and Observations Panel (GSOP) considered the development of ocean data syntheses at its 5th Session in Grenoble, France, on 11-13 May 2011. The CLIVAR SSG, at its most recent meeting, recommended increased interaction between GSOP and the Working Group on Ocean Model Development on the intercomparison, evaluation and development of ocean synthesis products and ocean models. The 4th International Reanalysis Conference is planned for May 2012 in USA.

Climate Change Detection and Indices (ETCCDI)

The CLIVAR/CCI/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) held its 4th session on 23-25 February 2011 in Victoria, Canada. Through its JCOMM representation, the Expert Team (ET) is exploring extending its scope to include marine indices. The ET is preparing a position paper on marine indices, variability and extremes that will include the usefulness of

developing a selected set of place-based indices and the possibility of extending land based indices to the ocean (e.g., linking SST to land surface temperature). ET will also explore the use of marine data to infer land indices where land observations are missing (e.g., for small islands).

WCRP regional oceanographic activities

Atlantic Ocean

As part of the coordination of Atlantic Meridional Circulation (AMOC) activities, CLIVAR Atlantic Implementation Panel (AIP) participated in the 3rd South Atlantic Meridional Overturning Circulation (SAMOC) workshop (Rio de Janeiro, Brazil, May 2010) and the 2010 US AMOC meeting (Miami, USA, June 2010). The AIP also sponsored a workshop entitled “Coupled Ocean Atmosphere Land Processes in the Tropical Atlantic” motivated by biases in coupled climate models common to the Atlantic and Pacific basins. These problems include the so-called “double ITCZ” (Intertropical Convergence Zone) systematic model error and an associated SST bias along the equator and in the southeastern tropical basins. Targeted observations and high-resolution modelling are improving understanding of the relevant processes and have encouraged a stronger physical basis to the boundary layer representation in climate models. A goal is to develop a coherent synthesis of existing knowledge for this region, to identify a network of interested researchers, and articulate an effective way forward.

Pacific Ocean

The CLIVAR Pacific Implementation Panel (PIP) met in Guayaquil, Ecuador on 15-16 October 2010, in association with a WCRP-cosponsored International Workshop on ENSO, Decadal Variability and Climate Change in South America (12-14 October 2010). The workshop participants recognized the importance of authoritative and reliable scientific information for developing effective risk management, mitigation and adaptation strategies in a world changing under the influence of human activity that is dependent on our understanding and ability to predict climate in the region on seasonal and longer time scales. Participants in the workshop “New strategies for evaluating ENSO processes in climate models” (17-19 November 2010, Paris, France) agreed to establish an inventory of the existing approaches and relevant observations. The panel also provides a forum for coordination of Pacific western boundary science projects. A highlight is the successful conclusion of a 52-day long investigation survey to the Northwestern Pacific as part of the Northwestern Pacific Ocean Circulation and Climate Experiment (NPOCE).

Indian Ocean

Under the coordination of the CLIVAR/GOOS Indian Ocean Panel (IOP), which met in Perth, Australia, 12-16 July 2010, the Research Moored Array for African–Asian–Australian Monsoon Analysis and Prediction (RAMA) continues to develop and is now some 59% complete. Also, four new buoys are planned to be deployed in 2011. Jointly with the Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER), a major regional activity under the IGBP IMBER Project and the biogeochemical and ecosystem research component of Indian Ocean GOOS, there are planned biogeochemical measurements to be made using the RAMA array. New instrumentation will be deployed that will provide data for defining biogeochemical variability in

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key regions of the Indian Ocean and for understanding the physical, biological and chemical processes that govern it.

The CINDY2011/DYNAMO process studies in the Indian Ocean region have been endorsed by CLIVAR. Their aim is to collect in-situ observations to advance our understanding of Madden-Julian Oscillation (MJO) initiation and to improve MJO prediction and simulation. The CLIVAR Indian Ocean Panel and the Pacific Panel have formed an Indonesian Throughflow (ITF) Task Team that will coordinate scientific efforts in the region. The Task Team will also provide a more complete description of the pathways, structure, and variability of the ITF (including related property transports), develop diagnostics and metrics for validation of ocean and climate models and improve data and product distribution from ITF programs.

The SCOR/WCRP/IAPSO WG 136 “Climatic Importance of the Greater Agulhas System” held its meeting on 20-21 February 2010, Portland, Oregon, USA. The significance of the transport of waters from Pacific and Indian by the Agulhas Current System that supports the Atlantic overturning circulation at a time when several other climatic factors tend to weaken it was recently published in (Beal et al., 2011)¹.

WCRP polar activities

The recent WCRP Workshop “Seasonal to multi-decadal predictability of polar climate (Bergen, Norway, 25-29 October 2010) reviewed the current state of knowledge of feedbacks and teleconnections that may be governing the polar climate change and lead to the existence of its predictable elements. The discussions made a solid input into the efforts of the community to develop a road map for Arctic climate prediction and design prediction experiments, data assimilation systems and models that will enable practical prediction of the Arctic climate on seasonal, inter-annual, and decadal scale. The sea-ice aspects of this work will continue under the CliC Arctic Sea-Ice Working Group (CASIWG). Expertise of this group is being extended to include not only sea-ice observations but also all sea-ice modeling aspects. The Workshop also recommended that the follow-on research in the Antarctic Region and Southern Ocean should encompass the whole system “stratosphere – troposphere – ice and ice shelves – ocean”. It is yet premature to speak about actual prediction of the climate system in that region, and the research there should focus on explaining the causes of observed trends and variability.

WCRP-coordinated polar research activities made a significant contribution to the International Polar year 2007-2008 (IPY) program. WCRP polar activities continue to contribute expertise and scientific knowledge to many, if not all, major polar and cryosphere initiatives including Sustaining Arctic Observing Networks (SAON), integrated Arctic Ocean Observing System (iAOOS), Southern Ocean Observing System (SOOS), the WMO Antarctic Observational Network (ANTON), Global Integrated Polar Prediction System, and the Global Cryosphere Watch (GCW). For example, CliC

¹ Lisa M. Beal, Wilhelmus P.M. De Ruijter, Arne Biastoch, Rainer Zahn, & SCOR/WCRP/IAPSO Working Group 136, 2011: On the role of the Agulhas system in ocean circulation and climate. *Nature* 472, doi:10.1038/nature09983

organized the “Satellite-derived Sea Ice Products Community Workshop” (Washington DC, USA, 15 and 16 March 2011). This meeting brought together algorithm developers, product distributors, operational organizations providing ice services, and users of such data and information. Participants in the Workshop discussed the large sea-ice climate records, different fields produced and used, with a view of evaluating and documenting them more thoroughly. They also reviewed intercomparisons of algorithms, errors/uncertainty estimates or confidence levels at grid point level, importance of data versioning and citing both products and input data, standards, documentation, conventions and methods (e.g., concentration threshold, land masks, etc.), and data formats. The future plans include consideration for a possible “ensemble” sea-ice extent estimate, which will comprise a key contribution to GCW, GOOS and GCOS.

Arctic Ocean

Together with the Arctic Monitoring and Assessment Programme (AMAP) and in cooperation with the International Arctic Science Committee (IASC), the WCRP Climate and Cryosphere (CliC) Project has been developing the Snow, Water, Ice and Permafrost in the Arctic (SWIPA) Assessment. The SWIPA project was established by the Arctic Council in April 2008 as a follow-up to the Arctic Climate Impact Assessment (ACIA). Its goal is to assess current scientific information on changes in the Arctic cryosphere, including the impacts of climate change on the ice, snow, and permafrost characteristics of the Arctic, which have potentially far reaching implications for both the Arctic and the Earth as a whole. CliC scientists have made a very strong contribution to the final SWIPA report, which was presented to the Arctic Council in May 2011 and will serve as an Arctic contribution to the IPCC AR5.

The CLIVAR SSG has asked its Working Group on Ocean Model Development and its Global Synthesis and Observations Panel to explore linkages with the Arctic Ocean research community and to seek guidance and advice on facilitating Arctic Ocean data synthesis. The development of the Polar Climate Predictability initiative as a pan-WCRP activity and ongoing consultations on the International Polar Decade initiative will provide the framework and opportunities for stronger collaborations. For example with the Arctic Ocean Science Board (AOSB), which acts now as the Marine Working Group of IASC, is planning to conduct a joint workshop with WCRP on IPY ocean data synthesis.

Southern Ocean

The science goals of the CLIVAR/CliC/SCAR Southern Ocean Region Implementation Panel (SOP) focus on furthering the objectives of the Southern Ocean Observing System (SOOS) and planning collaborative studies with emphasis on ocean carbon. The Southern Ocean Vision Document was finalized and a community paper on SOOS entitled “Rational and strategy for sustained observations of the Southern Ocean” is out for broad community input. The panel works closely with the SCAR/SCOR Oceanography Expert Group to move the SOOS Design Plan forward. The plan has now been completed, consulted upon and reviewed.

The role of sea-ice in the Antarctic will be studied under the renewed SCAR/CliC activity “Antarctic Sea Ice Processes and Climate” (ASPeCt). It will establish closer working relationships between the modelling and observing communities, identify the needs of the modelling community with respect

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to Southern Ocean data (scale issues, processes, properties, validation data), identify current observed data, determine whether current and planned observing systems are adequate to initialize models for decadal predictions, convey information to modellers, and promote interaction between modellers and observers. This group is also expected to contribute to the design and implementation of the SOOS.

Significant changes in the deep ocean were observed in the Southern Ocean and adjacent ocean basins. A workshop “Observed and Model Simulated Property Changes in the Deep Ocean of the Southern Hemisphere” was held on 21-23 June 2010 in Hobart, Australia. A working group was formed to write a synthesis peer-reviewed paper on Southern Ocean Antarctic Bottom Water (AABW) and deep ocean changes.

WCRP/IOC Task Group on Sea-Level Variability and Change

In 2009 the WCRP and IOC established the WCRP-IOC Task Group on Sea-Level Variability and Change (<http://www.wcrp-climate.org/SeaLevel.shtml>). The decision was made by the 30th Session of the WCRP Joint Scientific Committee (6-9 April 2009, College Park, Maryland, USA), and it was endorsed by the 25th Assembly of IOC. The Task Group addresses issues relevant to both global average of sea-level rise and also its variability in space and time. The overall goal of the group is to help improving our ability to monitor, explain, predict global and regional sea level and all environmental factors related to it, and use this information for decision making.

A small Steering Group co-chaired by J. Church and K. Steffen leads the Task Group. A meeting of the Steering Group was held in Bern, Switzerland, on 24 March 2010 where the following initial activities of the Task Group were identified:

- consideration of the growing number of statistical approaches for prediction of sea-level rise the 21st century,
- fostering analysis and synthesis of observational and model results for inclusion in the IPCC AR5 (e.g. through the IPCC Workshop “Sea Level and Ice Sheet Instabilities”, Malaysia, 21-25 June 2010) and preparation of a review paper for the IPCC AR5 process,
- preparation of a periodic status statement on global sea level (a two page note every year or two),
- development of links with those interested in the impacts of sea-level rise, and
- identification of groups preparing adaptation and mitigation strategies for coastal planning and development.

Some of these activities have already resulted in actions, For example, as a result of the workshop organized in June 2006 by WCRP and IOC, the book “Understanding Sea-Level Rise and Variability” was published in August 2010 (<http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1444334514.html>). The book identifies the major impacts of sea-level rise, presents up-to- date assessments of past sea-level change, thoroughly reviews all of the factors contributing to sea-level rise, and explores how sea-level extreme events might change. It describes what is known and

outlines the research and observations required to reduce the uncertainties in our understanding of sea-level rise so that more reliable future projections can be made. A synthesis of findings provides a concise summary of past, present and future sea-level rise and its impacts on society.

For the UNFCCC COP15 (Copenhagen, Denmark, December 2009), WCRP and WMO published an update on sea-level variability and change. The document reviews recent assessments of contributions to sea-level rise from the loss of mass of glaciers and ice sheets, combined with corrected estimates of the oceans' thermal expansion, resulting in the combined contributions to sea-level change.

A "Regional Sea-Level Workshop" was held in IOC, Paris, France, on 7-9 February 2011. It was called by the Task Group organized by CLIVAR/GSOP, and sponsored by WCRP. The workshop discussed regional changes of sea level in comparison with global changes, underlying their time and space scales and mechanisms. It confronted observed regional sea level changes with those inferred from numerical simulations and compared future predictions and their analysis in terms of processes. This process distilled current challenges and possible ways forward in observing, modelling and predicting the regional sea level.

The WCRP Open Science Conference

WCRP is organizing an Open Science Conference (OSC) to be held in 24-28 October 2011, in Denver, Colorado, USA (<http://conference2011.wcrp-climate.org/>). At this Conference, the WCRP will assemble, for the first time ever, its entire research community and engage other key international research programmes. Through a synthesis of research findings, the OSC will assess our current state of knowledge on climate variability and change, identify the most urgent scientific issues and research challenges, and ascertain how the WCRP can best facilitate research and develop partnerships critical for progress. The OSC will appraise the current state of climate science, thereby making a measurable contribution to the IPCC AR5. It will identify key opportunities and challenges in observations, modeling, analysis and process research required to understand and predict responses of the Earth as a system. By entraining as many young scientists and students as possible from across the world, including less-developed and developing countries, the OSC will facilitate growth of the diverse future workforce needed to meet the increasingly complex scientific challenges of the future. There are several plenary talks on ocean observations and research. In each thematic area of the OSC there is an ocean subset.

WCRP and international climate change policy fora

Through the activities aimed at improving the scientific understanding of climate and transferring the new knowledge to environmental assessments (e.g. of ozone, climate, water, etc.), WCRP makes an important contribution to the UNFCCC process and the development of the post-Kyoto regime. WCRP also made great strides in providing the scientific information and knowledge about the Earth's climate system for policy decisions through the IPCC, the UNFCCC Conference of Parties, and its Subsidiary Body for Scientific and Technological Advice (SBSTA).

WCRP and climate services

WCRP-affiliated scientists played a major role in the success of the World Climate Conference-3 held in Geneva in August 2009 (http://www.wmo.int/pages/gfcs/index_en.html). The High-Level Segment of the Conference agreed to establish a Global Framework for Climate Services (GFCS) to strengthen production, availability, delivery and application of science-based climate prediction and services. Strengthening of WCRP as well as Earth system science and GCOS is seen as key to a successful GFCS.

WCRP will support the implementation of the Global Framework of Climate Services by 1) strengthening and mainstreaming research observations to serve as prototypes for future climate observing systems; 2) developing climate prediction systems with lead times from seasons to centuries; 3) ensuring development of reliable high-resolution products needed for climate adaptation and risk management; 4) promoting interdisciplinary research to develop sector applications, tools and tailored information; 5) facilitating flow of user requirements to the research community and climate services sectors through user feedback; and 6) improving the availability of highly-skilled talent to undertake climate research, operational prediction, and communication, particularly in the developing regions/countries.

Capacity development and partnerships

WCRP entrains many scientists, especially the early career scientists from developing regions and nations, into its activities. Many of the scientific and technical workshops that WCRP organized during last year offered travel grants to students and early career scientists, to ensure their full engagement in these events and follow-up activities. WCRP is planning to reinforce, on a sustained basis, such support in future events. A significant support program for early career and developing country scientists is being implemented as a part of preparations for the WCRP OSC. WCRP will continue to pursue its two pronged approach to capacity development by: 1) providing support to scientists from developing countries, and 2) building the research community of the future to ensure the transfer of appropriate skills and knowledge for the development of Earth system science and provision of resulting knowledge for decision makers.

WCRP continued to build on its existing partnerships with other international research programmes such as the IGBP on biogeochemical aspects, the International Human Dimensions Programme on Global Environmental Change (IHDP) on social and human dimensions of climate change research, and with the global Change SysTem for Analysis, Research and Training (START) and regional organizations such as the Asian-Pacific Network (APN) and the Inter-American Institute (IAI) on capacity building, education and outreach. The WCRP work with START promotes research-policy dialogues in order to integrate climate change adaptation in development planning. The project involves the WMO, UNEP, the IPCC, START, the Universities of Ghana and Dar es Salaam, and the Bangladesh Centre for Advanced Studies.

WCRP, through its affiliated scientists, serving on the organizing Committee is contributing to the preparations of the second 2nd PICES/ICES/IOC Symposium “Effects of climate change on the

world's oceans" (Yeosu, Republic of Korea, 15-19 May 2012, in conjunction with Ocean Expo-2012).

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7.1.3 Scientific Committee on Antarctic Research (SCAR)

Wainer

The major joint activity between the SCOR and SCAR for the past several years has been the SCAR/SCOR Group of Experts on Oceanography. The major activity of this group is been production of a plan for a Southern Ocean Observing System (SOOS). The plan has been reviewed and is being prepared for publication:

Rintoul, S.R., M.D. Sparrow, M.P. Meredith, V. Wadley, K. Speer, E. Hofmann, C. Summerhayes, E. Urban, and R. Bellerby (eds.). 2011. *The Southern Ocean Observing System: Initial Science and Implementation Strategy*. Scientific Committee on Antarctic Research and Scientific Committee on Oceanic Research.

The document will be posted on the Web when it is published. A small number of paper copies of the report will be printed at the University of Delaware for distribution to the scientific community and potential sponsors of SOOS activities.

A one-person (for now) SOOS office has been established in Hobart, Tasmania, Australia and the Executive Officer (Louise Newman) has been selected. Newman is currently working in the International Project Office of the PAGES project and will commence her duties in the SOOS office in August 2011. The SOOS steering committee will be formed in the next few months and we are aiming for its first meeting in early 2012.

SCAR is setting up Ocean Acidification Action Group, chaired by Richard Bellerby, Bjerknes Centre for Climate Research, Norway. The Action Group will:

- define our present understanding of the contemporary rates and future scenarios of Southern Ocean acidification;
- document ecosystem and organism responses from experimental perturbations and geological records;
- identify present and planned observational and experimental strategies;
- identify gaps in our understanding of the rates and regionality of ocean acidification;
- define strategies for future Southern ocean acidification research.

The above workplan will be performed in consultation with existing global ocean acidification efforts (e.g SOLAS/IMBER Sub Group 3, US Ocean Carbon Biogeochemistry and the SCAR ICED and the SCAR Oceanography Expert Group).

7.2 Affiliated Organizations

7.2.1 International Association for Biological Oceanography (IABO) *Costello*

7.2.2 International Association for Meteorology and Atmospheric Sciences (IAMAS) *MacCracken*

7.2.3 International Association for the Physical Sciences of the Ocean (IAPSO) *Morozov*



IAPSO Report to SCOR

A new IAPSO Executive Committee was elected in Melbourne, at the 25th General Assembly of IUGG.

EC MEMBERS FOR 2011-2015:

President:	Dr. Eugene Morozov (Russia)
Secretary General:	Prof. Johan Rodhe (Sweden)
Past President:	Prof. Lawrence Mysak (Canada)
Treasurer:	Dr. Fred Camfield (USA)
Vice President:	Dr. Isabelle Ansorge (South Africa)
	Dr. Denise Smythe-Wright (UK)
EC Member:	M.Sc. Silvia Blanc (Argentina)
	Prof. Toshiyuki Hibiya (Japan)
	Dr. Chris Meinen (USA)
	M.App.Sc. Ken Ridgway (Australia)
	Dr. Satheesh Shenoi (India)
	Dr. Stefania Sparnocchia (Italy)

2007-2011 IAPSO ACTIVITIES

In 2009 in Montreal, we had 8 IAPSO led symposia and a few more joint symposia. In 2011, in Melbourne we had 7 IAPSO led symposia and 3 joint symposia. We are attempting to organize the symposia, which would reflect the most interesting oceanographic researches and attract many participants.

IAPSO awards the Albert I medal for outstanding research in physical and chemical oceanography. In 2009, the Price Albert I Medal was awarded to Prof. Harry Bryden. The

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previous medalists were Drs. W. Munk (2001), K. Wyrski (2003), F. Schott (2005), and R. Davis (2007). The sixth medalist was Dr. Trevor McDougall from Australia. He was awarded this prize in 2011 during the Assembly in Melbourne.

Our association, IAPSO, also awards the “Eugene LaFond Medal”, to a developing world scientist who presents a notable paper at an IAPSO symposium. Following a review of the nominations for this award after the Montreal meeting (2009), the EC decided to present this medal to Bamol Sow from Senegal. In 2011, the IAPSO EC decided to present the LaFond medal to Towhida Rashid from Bangladesh for her presentation about the sea level change in the Holocene.

It was also noted that there were relatively few IAPSO delegates in Melbourne, about 300. These low turnouts can in part be attributed to the difficulty and expense in getting to Australia and high cost of the registration fee. An ash cloud from Chile caused suspension and cancellations of many flights to Melbourne and this was an unexpected obstacle for many participants to arrive in time. The new EC hopes that many more delegates and National Correspondents, will attend the 2013 IAPSO Assembly in Gothenburg.

Over the past few years we jointly sponsored together with SCOR a number of working groups, namely, WG 121: Ocean mixing (now disbanded); WG 127: Thermodynamics and equation of state of seawater; WG 129: Deep ocean exchanges with the shelf (DOES), WG 133: Ocean Scope, and WG 136: [Climatic Importance of the Greater Agulhas System](#). The WG 127 has recently developed a new International Thermodynamic Equation of Seawater -2010 (TEOS-10). It was adopted by the Intergovernmental Oceanographic Commission (IOC).

IAPSO-IAHS-IASPEI JOINT ASSEMBLY IN GOTHENBURG, 22-26 JULY 2013

The next assembly of IAPSO will be held jointly with IAHS and IASPEI in 2013, the midway point between IUGG General Assemblies.

In 2011 in Melbourne, we started to plan the IAPSO symposia and identify appropriate conveners for the Gothenburg assembly.



Eugene Morozov

President, IAPSO

and

Head of the Hydrological Processes Lab. at the Shirshov Institute in Moscow, Russia.

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7.3 Affiliated Programs

SCOR-Affiliated Projects and Programs

SCOR sponsors many, but not all, of the major international ocean research projects and programs. Some projects not co-sponsored by SCOR can gain benefits from association with SCOR, such as (1) increased visibility; (2) participation in SCOR activities, such as project coordination meetings and annual SCOR meetings; (3) opportunities to provide comments on working group proposals and membership; (4) access to national SCOR contacts; and (5) opportunities to apply for SCOR funding for travel of scientists from developing countries and countries with economies in transition to their workshops and symposia. In 1995, SCOR developed the option of formal affiliation of relevant projects/programs with SCOR. Unlike projects sponsored by SCOR, affiliated projects and programs receive funding from organizations besides SCOR and do not need staff support from SCOR.

SCOR's role in relation to affiliated projects and programs is one of advice and regular review. SCOR gives advice about appropriate balances on the projects' steering committees and adequate rotations of these committees to renew the committees' memberships regularly. SCOR's national contacts can be used to find new members in regions where there is a need, or to entrain new countries into projects. SCOR can also provide an independent mechanism for the review of planning documents such as science or implementation plans.

Application for SCOR Affiliation

Application to SCOR for program affiliation should be initiated with a proposal of 2 to 5 pages, sent to SCOR at least three months before an annual SCOR meeting. The proposal should include an outline of the program's science plan, the terms of reference, current membership of the steering committee, and rotation procedures and schedule. The proposal for SCOR affiliation should also address the following criteria, accepted at the 1995 SCOR Executive Committee meeting (see *1995 SCOR Proceedings*). The Executive Committee agreed that in order to become a SCOR-affiliated project/program, an activity must

- be truly international, with a committee membership that rotates on a regular basis;
- show evidence of existing financial and/or organizational support;
- demonstrate a benefit from SCOR affiliation;
- have a scientifically well-integrated theme;
- show that it is in SCOR's interests to establish this affiliation;
- be of broad scale and global importance;
- show, as appropriate, that any scheme of membership dues includes some nominal level so as to encourage the widest possible international participation by all countries; and
- be willing to adhere to the SCOR Publication Policy.

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After a program is affiliated with SCOR, annual reports are required, and scientific presentations may be requested at any annual SCOR meeting, as a basis for the decision on continuing the relationship between SCOR and each project/program. The Chair of each affiliated project/program serves as an ex-officio member of SCOR as a Scientific Rapporteur (see SCOR Constitution, paragraph 4). Continued affiliation with SCOR depends on the project meeting the guidelines specified above, and maintaining high scientific quality and adequate rotations of committee members and chairs.

Reports to SCOR

Annual reports to SCOR should answer the following questions and present any additional information that the project/program would like to transmit to SCOR:

- What scientific accomplishments have been achieved by the project/program in the past year?
- How has the project's steering committee membership changed in the past year?
- What is the financial status of the project?
- What is the status of the project's secretariat?
- What are the plans for the scientific development and implementation of the project over the next two to three years?
- How is the project interacting with and contributing to other SCOR activities?

In addition, projects/programs should communicate regularly with their SCOR Executive Committee Reporter regarding their activities and progress.

7.3.1 International Marine Global Change Study (IMAGES) (affiliated in 1995)

Compton

IMAGES (International Marine Global Change Study) is a program of Past Global Changes (PAGES), a core project of the International Geosphere-Biosphere Programme (IGBP), and is affiliated with SCOR. IMAGES was initiated to respond to the challenge of understanding the mechanisms and consequences of climatic changes using oceanic sedimentary records. The overriding IMAGES science issue is to quantify climate and chemical variability of the ocean on time scales of oceanic and cryospheric processes; to determine its sensitivity to identified internal and external forcings, and to determine its role in controlling atmospheric CO₂. In order to achieve these scientific objectives, IMAGES proposes to coordinate a global program to collect and study marine sediment records to address three fundamental questions:

1. How have changes in surface ocean properties controlled the evolution of global heat transfer through the deep and surface ocean and thereby modified climate?
2. How have changes in ocean circulation, ocean chemistry, and biological activity interacted to generate the observed record of atmospheric pCO₂ over the past 300 kyr?
3. How closely has continental climate linked to ocean surface and deep-water properties?

Chair:

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B. Flower	USA	A. Mackensen	GERMANY
F. Grousset	FRANCE	H. Neil	NEW ZEALAND
I. Hall	UK	B. Opdyke	AUSTRALIA
E. Ivanova	RUSSIA	T. Pederson	CANADA
E. Jansen	NORWAY	V. Ramaswamy	INDIA
Z. Jian	CHINA	J. Rogers	SOUTH AFRICA
N. Kallel	TUNISIA	J. Sopaheluwakan	INDONESIA
H. Kawahata	JAPAN	T. Stocker	SWITZERLAND
K.L. Knudsen	DENMARK	A. Völker	PORTUGAL
D. Kroon	NETHERLANDS		

Director: Ralph Schneider

Executive Committee Reporter: John Compton

IMAGES Report in preparation for the SCOR General Meeting, September 2011, Helsinki, Finland

IMAGES (International Marine Global Change Study) Marine Program of IGBP-PAGES

IMAGES (International Marine Global Change Study) is a core project of the International Geosphere-Biosphere Programme (IGBP), and has been affiliated with SCOR since 1995. IMAGES was originally initiated to respond to the challenge of understanding the mechanisms and consequences of climate change using oceanic sedimentary records. In broad terms, the scientific issues that have been addressed by IMAGES over its 15 year history are: (i) the role of ocean circulation in climate change; (ii) the role of marine biogeochemical cycles in the regulation of atmospheric CO₂ including perspectives from the past; (iii) the impact of ocean changes on continental environments through land-ocean interactions and on human evolution and civilization; (iv) the response of oceanic biota and ecosystems to climate and environmental change; and (v) the development and application of novel new methods (“proxies”) to quantify ocean variables and key processes that defined states of ocean circulation and climate in the past. To achieve these aims, IMAGES has organized sea-going missions to collect and study long, high-resolution marine sediment records and provided support (or co-funded support) for thematic and regional working groups that identify high-priority science and coring targets, or that carry out large-scale data synthesis efforts. In addition, IMAGES has organized special sessions at large international meetings, workshops and conferences, and has actively encouraged, promoted, and supported the participation of students and early career scientists in its full range of activities. IMAGES-collected materials and research to date have resulted in more than 800 peer-reviewed research publications in high impact journals and have led to the completion of over 150 Ph.D. and Master’s theses at universities around the world. Funding of IMAGES activities has been wholly achieved through a combination of modest subscriptions/donations from member countries and the collective contributions of participating scientists in cruise campaigns.

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IMAGES Office

The program has an interim office now hosted at the University of Kiel in Germany.
(Birgit Reiner, Tel. +49 (0)431.880.4000, Email: breiner@gpi.uni-kiel.de)

General Information

Although IMAGES is still working to foster and facilitate marine paleoclimate research, the program has been in a reduced state of activity as it endeavors to transition to a new and reinvigorated phase, IMAGES II. No new increments of annual funding have been received from IMAGES national members or partner institutions during this program lull and what expenditures have been made have utilized residual funds. In order to plan for the future development of IMAGES, a small core group of international scientists met in Brussels in late January 2011. A major objective of this meeting was to review and reach consensus on the new Science Plan for IMAGES Phase II. Final revisions, based on that meeting, have been made and the plan is circulating for approval. As with its predecessor, IMAGES II will not fund research but will serve as a focal point for the pooling of global expertise, funding, and resources that maximizes individual contributions by assimilating them into an internationally integrated and thematically coherent science entity whose mission is to understand the role of marine processes in climate change. At its core, IMAGES II will be a unifying, science-driven, platform independent program built on a foundation of high quality, fully integrated proxy measurements and synthesis efforts. At Brussels, a strategy was outlined for how to best implement the new Science Plan as well as how to revitalize the program and re-engage the financial support from partner institutions and third-party funding that makes the work of the IMAGES community possible.

Working Groups

Over the last year IMAGES has expended funds in support of two joint PAGES-IMAGES working groups: 1) PALSEA (*Paleo-constraints in sea level rise*), and 2) NICOPP (*Nitrogen Cycling in the Ocean, Past and Present*). In addition, IMAGES is represented in the SCOR/WCRP/IAPSO working group 136 focusing on the *Climatic Importance of the Greater Agulhas System*.

Young Scientist Support

A total of 28 graduate students and early career researchers from more than nine countries received an IMAGES contribution to their travel and conference fee expenses in order to

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attend the 10th International Conference of Paleoceanography (ICP 10), held at the Scripps Institution of Oceanography, San Diego, August 29 – September 3, 2010.

7.3.2 InterRidge - International Ridge Studies (affiliated in 1996)

Compton

Terms of reference:

- To build and maintain an interactive international ridge-research community
- To identify, through InterRidge working groups and the workshops and conferences they organize, the most compelling questions in ridge research and develop program plans to address these questions
- To continue to develop scientific, technical and logistical co-operation among nations and to strengthen international foundations for innovative research.
- To provide current information about research activities through the InterRidge website and *IR News*.
- To encourage participation of smaller oceanographic countries and individual scientists from non-seagoing countries.
- Through education and outreach, to communicate the importance and excitement of ridge research to the general public and decision makers worldwide.
- To act as a representative body for international ridge scientists in policy discussions.

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Donna Blackman	USA	Timothy Henstock	UK
John Chen	CHINA-Beijing	Sung-Hyun Park	KOREA
Paul R. Dando	UK	Rosario Lunar	SPAIN
Colin Devey	GERMANY	Rolf Pedersen	NORWAY
Nicole Dubilier	FRANCE	K.A. Kamesh Raju	INDIA
Jérôme Dymant	USA	Nobukazu Seama	JAPAN
		Steve Scott	CANADA

Coordinator: Debbie Milton

Executive Committee Reporter: John Compton

2011 InterRidge Update for SCOR

The InterRidge (IR) programme office is now in its second year at the National Oceanography Centre, Southampton, UK. It is led by a multidisciplinary team: Bramley Murton (IR Chair, marine geology, geochemistry) and Jon Copley (IR CO-Chair, marine ecology, specialising in chemosynthetic ecosystems). The Office Co-ordinator is Debbie Milton, whose background is in physical geography and education.

Whilst the number of national and regional memberships remains at 64, associations have been strengthened by the appointment of three new National Correspondents for Australia, New Zealand and Mexico. Individual IR membership is ~2600. The bi-weekly "interridge-mail" e-news is received by ~1200 IR members and ~180 members obtain job postings by subscribing to the interridge-classifieds mailing list.

InterRidge (<http://www.interridge.org>) promotes interdisciplinary, international studies of oceanic spreading centres by creating a global research community, planning and coordinating new science programmes that no single nation can achieve alone, exchanging scientific information, and sharing new technologies and facilities. InterRidge is also dedicated to reaching out to the public, scientists and governments, and to providing a unified voice for ocean ridge researchers worldwide. An increasing role for InterRidge is our involvement in compiling information and advice for policy makers. This includes meetings and workshops where protocols for codes of scientific conduct for studying chemosynthetic environments, and identifying sites of special scientific interest, are proposed and discussed. InterRidge also has formal links with the United Nations Environment Programme and informal links with the Integrated Ocean Drilling program and the International Seabed Authority.

Working Groups are the principal mechanism for achieving the InterRidge programme, their main function being to identify new areas of high priority scientific research. Each Working Group has clear goals and a timescale in which to achieve them (approx. 5 years). InterRidge supports those scientific projects which would benefit from IR coordination by convening group meetings, community-wide workshops, symposia and theoretical institutes. The resulting reports represent a synthesis of international and interdisciplinary efforts to define scientific questions and a methodology of addressing them. There are currently five active IR Working Groups in 2011.

Examples of IR-led Working Group activity in 2011:

Mantle Imaging WG workshop

(Contact: Nobukazu Seama, Japan)

The WG is convening a workshop in October 2011 at AORI, University of Tokyo, Japan, titled: "Ocean Mantle Dynamics: From Spreading Centre to Subduction Zone". Potential participants

will include those who work on results from large-scale experiments, rock laboratory experiments, petrology, and numerical modelling.

Seafloor Mineralisation

(Contact: Maurice Tivey, USA)

As a result of an IR co-sponsored workshop in 2010, a paper by Prof. Cindy Van Dover was published in *Nature*, Vol 470, 3 February 2011, entitled: "Tighten regulations on deep-sea mining". Results will also be presented to the Legal and Technical Commission, ISA in June 2011.

The IR Office requested a list of vent sites that should have priority protection. This list has been sent to the ISA for consideration with the Chinese and Russian applications for exploration licences for polymetallic sulphides.

InterRidge co-sponsoring SCOR WG 135: *Hydrothermal energy and ocean carbon cycles* (Contact: Nadine Le Bris, France, and Chris German, USA).

This WG will be holding its second meeting in October 2011 in Hangzhou, China, followed by a major community-wide meeting at a European venue in 2012.

The results of a survey of the InterRidge Statement of Commitment to Responsible Research Practices at Deep-Sea Hydrothermal Vents have been published at:

<http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2010.01642.x/full>. The previous IR Coordinator, Stace Beaulieu, produced a revised, on-line vents database, which is available from the InterRidge website <http://www.interridge.org/IRvents>.

Other InterRidge Office activities in 2011

In 2011 we completed awarding the initial grant from the International Seabed Authority and awarded three Fellowships to early-career scientists from developing countries. We also awarded two Fellowships from InterRidge funds. All Fellowships are designed to encourage international collaboration on any aspect of ridge-crest science.

InterRidge has also launched its new Cruise Travel Bursary scheme. This has enabled three early-career scientists to make new collaborations with established scientists, with InterRidge paying their travel and hotel costs. Details at: <http://www.interridge.org/bursary/list>

For more information about IR's activities and national updates, please visit the IR website (<http://www.interridge.org>) and recent newsletters (<http://www.interridge.org/IRNewsletter>), or contact the IR Office (coordinator@interridge.org) for a hard copy of the 2011 InterRidge News, which will be published in Nov. 2011.

7.3.6 International Ocean Colour Coordinating Group (IOCCG) (Affiliated in 1997)

Volkman

IOCCG is an international group of experts in the field of satellite ocean colour that acts as a liaison and communication channel between users, managers, and agencies in the ocean colour arena.

Terms of Reference:

- To serve as a communication and coordination channel between data providers and the global user community of satellite ocean-colour data, and so to maximize the benefits that accumulate from international investments in ocean-colour science and technology.
- To construct a partnership, at the international level, between the space agencies and the users of satellite ocean-colour data to develop and coordinate data utilization.
- To work closely with the appropriate international bodies (including CEOS, IOC and SCOR), international scientific programs (such as IGBP and GOOS), satellite ocean-colour mission offices and other agencies (such as environmental and fishing agencies) to harmonize the international effort and advance ocean-colour science and its applications.
- To develop a collective voice for the community of users of ocean-colour data and to articulate this voice to the appropriate international bodies, international scientific programs and space agencies.
- To promote the long-term continuity of satellite ocean-colour data sets; the development of operational, ocean-colour data services and new generations of ocean-colour sensors; and the integration of data from complementary ocean sensors.

Chair:

David Antoine

Membership:

Yu-Hwan Ahn	KOREA		
David Antoine	FRANCE	Milton Kampel	BRAZIL/INPE
Stuart Bernard	SOUTH AFRICA	Samantha Lavender	UK
Hans Bonecamp	Eumetsat, EC	Zhihua Mao	CHINA-Beijing
Paula Bontempi	USA/NASA	Hiroshi Murakami	JAPAN
Yves Crevier	CANADA	Rangnath Navalgund	INDIA
Curtiss Davis	USA/Naval Res. Lab	Peter Regner	ITALY
Paul DiGiacomo	USA	Tasuku Tanaka	JAPAN
Roland Doerffer	GERMANY	Eric Thouvenot	FRANCE/CNES
Mark Dowel	ITALY/JRC	Scarla Weeks	AUSTRALIA
Nicolas Hoepffner	ITALY/JRC		

Executive Committee Reporter: John Volkman

Project Scientist: Venetia Stuart

International Ocean-Colour Co-ordinating Group (IOCCG)**Report of Activities 2010 - 2011****Venetia Stuart (IOCCG Project Scientist)*****1. Background***

The International Ocean-Colour Co-ordinating Group (IOCCG) was established in 1996 to develop consensus and synthesis at the world scale in the subject area of satellite ocean colour radiometry (OCR). The group promotes communication and co-operation between the various international space agencies providing ocean-colour data and user groups around the world (students, research scientists, program managers). The IOCCG has been an Affiliated Program of SCOR since 1998. This affiliation to SCOR is critical in that it provides an avenue for obtaining funding from US agencies such as NASA and NOAA. The IOCCG greatly appreciates the efficient and professional manner in which the NASA funds are managed by SCOR. In addition, the IOCCG has been strengthened by having visible links with one of the major international and intergovernmental organizations in the marine sphere.

The IOCCG has a wide-ranging mandate - the group addresses scientific issues through a number of scientific working groups, it is involved in capacity building in both developing and developed countries, and helps to ensure the continuity of the ocean-colour data stream through the CEOS Ocean Colour Radiometry-Virtual Constellation (OCR-VC). The group is currently chaired by David Antoine (LOV, Villefrance, France) and the IOCCG Project Office is located at the Bedford Institute of Oceanography, Canada, staffed by Project Scientist, Venetia Stuart.

2. Scientific Accomplishments

Scientific activities related to OCR are carried out by specialized IOCCG scientific working groups which investigate various aspects of ocean-colour technology and its applications, and produce a report on the topic, published in the growing IOCCG Report Series (10 reports published to date). These reports are always in high demand by scientists, managers and students from around the world and are frequently used as a teaching tool in training courses. Information on the current active IOCCG working groups is given below.

2.1 *Bio-Optical Sensors on Argo Floats*

This WG, chaired by Hervé Claustre, (Laboratoire d'Océanographie de Villefranche, France) investigated the feasibility of equipping Argo floats with optical/biogeochemical sensors to provide high density, biogeochemical data at relatively low cost. Bio-optical sensors on Argo floats are a promising avenue for calibration/validation of satellite ocean colour data. The WG examined the scientific and strategic challenges of designing such a program based on Argo float technology and proposed three types of floats: the CAL-VAL-float for validation, the BIO-ARGO float for biogeochemistry plus validation, and the Carbon-Explorer float for a complete range of biogeochemical measurements, including carbon. The VAL-and BIO-Argo floats are based on commercially-available sensors and can readily become components of existing Argo arrays. Prototype VAL-floats will be tested over the 2011-2012 period, and if the concept proves to be scientifically valid and cost-effective, an operational VAL-float array will be implemented. For the Bio-Argo floats the WG recommended that a regional network be implemented in certain “hot-spots” as the cost of a global array would be prohibitive. The WG has produced a report on this topic entitled “*Bio-Optical Sensors on Argo Floats*” edited by Hervé Claustre, which will be published by the IOCCG later this year, and will be printed by the EU Joint Research Centre (JRC).

2.2 *Ocean Colour from a Geostationary Platform*

This WG, chaired by David Antoine (Laboratoire d'Océanographie de Villefranche, France), addressed requirements of ocean-colour observations from a geostationary orbit. Geostationary missions have the capability to provide multi-spectral ocean colour observations at a high revisit frequency, which can be used to address many critical oceanographic issues such as the diurnal variability of optical and biogeochemical properties, the coupling between physics and biology at meso- and sub-mesoscales, the quantification of sediment and carbon transport, and data assimilation into coupled ocean physical-ecosystem models. Geostationary ocean colour imagers have significantly improved temporal sampling compared to polar orbiting ocean colour sensors, and they may also have improved spatial and spectral sampling which will greatly enhance our ability to monitor and assess the dynamics of the coastal ocean. South Korea has already launched the COMS geostationary mission carrying the GOCI ocean colour sensor (June 2010) and several other space agencies have plans to develop a geostationary ocean-colour sensors, so the working group is very timely. The WG has submitted an advanced draft report. The final report will be published by the IOCCG early next year, and will be printed by NOAA.

2.3 *Level-1 Requirements*

This WG, co-chaired by Chuck McClain, Gerhard Meister and Paula Bontempi (all from NASA, USA), was formed because the requirements for ocean-colour sensors have changed dramatically over the past 10 years in light of the advancement of our science questions, and application of ocean colour data to operational problems. Geographically and optically, the areas of interest have been expanded beyond Case I (open ocean) waters into the range of optically-complex, coastal waters. It is now possible to measure more complex ocean variables, as well as physiological features of phytoplankton using OCR, leading to more stringent requirements for the new generation of ocean radiometers. The WG set out to establish the minimum basic radiometric and sensor requirements

for detailing global observations of the ocean's chemistry and biology from space. The report recognizes the value of a continuous time series of global, climate quality, ocean colour data to support a virtual constellation of ocean colour sensors, and enable large-scale oceanographic research programs. The WG has addressed the relevant science questions and ocean properties that can be measured, and has updated the current suite of mission requirements (including radiometer design and characterisation, system requirements, data product and processing requirements). The WG has had two meetings (US and UK) and has produced an advanced draft report. The final report will be published by the IOCCG early next year.

2.4 Joint GEOHAB/IOCCG WG on Harmful Algal Blooms

This is a joint working group between the IOCCG and GEOHAB (IOC-SCOR), and is chaired by Stewart Bernard (CSIR, South Africa). The main goal of the WG is provide a resource that improves communication between the OCR and HAB scientific communities. The use of ocean colour techniques and products is a powerful and cost-effective way of observing many HAB outbreaks. Over the next few years, the working group will use a number of case studies to demonstrate ocean colour utility and performance of both commonly available, and emerging, ocean colour techniques for specific bloom/ecosystem examples. The WG is also reviewing available algorithms from a HAB perspective, and will provide some algorithm inter-comparison through the case studies. The first working group meeting took place in Cape Town, South Africa (August 2010) and was co-sponsored by SCOR. At the meeting various case studies were discussed and the structure of an IOCCG/GEOHAB monograph was outlined. A second meeting of the WG will take place after the GEOHAB Scientific Steering Committee meeting (Plymouth Marine Laboratory, November 2011). Information and data for the case studies will be prepared ahead of time.

In addition to the current working groups listed above, there are a number of newly-formed IOCCG working groups that are still establishing membership. They plan to hold their first working group meeting in the coming year. These working groups include:

- i) **Working group on Polar Seas** to be chaired by Marcel Babin (University of Laval, Canada). The working group will be established to investigate the use of ocean colour radiometry in the Arctic and Antarctic Oceans. Potential difficulties of using ocean-colour remote sensing over the Arctic Ocean include high CDOM absorption and high phytoplankton 'package effects' leading to problems with current algorithms. Cloud cover is also an issue as well as the low prevailing sun elevations .
- ii) **Working group on Uncertainties in Ocean-Colour Remote Sensing**, chaired by Roland Doerffer (GKSS, Germany). There are inherent difficulties with atmospheric correction in coastal waters, which can lead to large sources of error and retrieval uncertainties. Procedures are required to detect conditions which are out of scope of an algorithm, and to determine the remaining uncertainties on a pixel-by-pixel basis, which is the goal of the working group.
- iii) **Round-Robin Inter-Comparison of Retrieval Algorithms for Coastal Waters**, proposed by Kevin Ruddick (Royal Belgian Institute of Natural Sciences). The objectives of this WG are

to examine how algorithm performance relates to algorithm design and calibration, and will focus on algorithms for coastal waters.

3.0 Continuity of the Ocean Colour Data Stream through the OCR-Virtual Constellation (OCR-VC)

IOCCG is an associate member of the CEOS, whose role is to coordinate Earth observation satellites and to act as the main implementation body for the space segment of GEOSS (Global Earth Observation System of Systems). The Group on Earth Observations (GEO), in turn, coordinates international efforts to build a GEOSS, targeted at nine societal benefit areas, via a number of tasks. In this regard, the IOCCG contributes directly to two GEO tasks: AG-06-02 (Data Utilization in Fisheries and Aquaculture) through the SAFARI Project, and GEO Task AR-09-02 (Interoperable Systems for GEOSS) through the Ocean Colour Radiometry-Virtual Constellation (OCR-VC). As far as IOCCG is concerned, the highest priority is the Global Climate Observing System (GCOS), which has specified ocean colour as one of its key Essential Climate Variables (ECVs). This gives IOCCG an opportunity to promote continuity of ocean-colour satellite missions through the OCR-VC.

The OCR-VC will help to provide a long time series of calibrated ocean-colour radiances at key wavelength bands from measurements obtained from multiple satellites. The OCR-VC Implementation Plan includes elements of calibration, validation, merging of satellite & *in situ* data, product generation, development and demonstration of new and improved applications, as well as capacity building activities. The IOCCG recently established the INSITU-OCR network (*International Network for Sensor InTercomparison and Uncertainty assessment for Ocean Colour Radiometry*) to promote a concerted inter-agency effort on activities relating to sensor inter-comparison and uncertainty assessment of datasets required for ECV generation. The INSITU-OCR is currently a major priority of the OCR-VC, and the community is planning to produce a white paper later this year. All space agency representatives serving on the IOCCG Committee fully support the OCR-VC and are taking a leadership role in the activities.

4.0 Capacity Building Initiatives

The IOCCG has a strong interest in training and capacity building and was instrumental in preparing a handbook of satellite remote sensing image interpretation, with a focus on applications for marine living resources conservation and management. The handbook is intended as a web-based educational/training document oriented towards the interpretation of satellite images derived from data freely-available from various space agency archives. The current knowledge in this field is represented through a number of case studies which guide the end-users on how to download and interpret the satellite-derived image data. The case studies cover a range of applications including fisheries and aquaculture, phytoplankton and macroalgae, marine ecosystem characterization and

air/water quality. The handbook was developed in conjunction with the EU PRESPO Project for sustainable development of the artisanal fisheries in the Atlantic area (within the INTERREG- IVB Programme). An electronic beta-version of the handbook can be downloaded from the IOCCG website at: <http://www.ioccg.org/handbook.html>. The final version will be published shortly.

Over the past decade the IOCCG has played an important role in training and capacity building on a global scale. Most of the training has been devoted to capacity building in developing countries, and to ocean colour applications intended to give participants practical skills rather than fundamental knowledge. Next year the IOCCG intends to offer a recurrent summer lecture series, dedicated to high-level training in the fundamentals of ocean optics, bio-optics and ocean colour that will focus specifically on current critical issues in ocean colour science.

5. Project Management and Coordination

5.1 Annual IOCCG Committee Meeting

The IOCCG Committee meets once a year to coordinate the activities of the group as a whole, and to review the progress of the various working groups, discuss plans for the year ahead and propose new working groups and training initiatives. The last meeting of the IOCCG Committee was hosted by the Plymouth Marine Laboratory (PML, UK), and took place in Devon, UK from 15-17 February 2011. The minutes of the meeting are available on the IOCCG website at: http://www.ioccg.org/reports/Minutes_IOCCG_16.pdf. The next IOCCG Committee meeting is scheduled to take place in Denpasar, Indonesia from 28 February to 1 March 2012.

5.2 Outreach

The IOCCG connects with the global user community through a variety of outreach information schemes including a website, newsletters, training courses, brochures, reports and information sessions at conferences and workshops. The comprehensive IOCCG website (see <http://www.ioccg.org>) provides a wealth of information on data sources, software, training opportunities, conferences, an extensive bibliography, employment opportunities and status of current and future ocean-colour sensors. In addition, a quarterly electronic newsletter is distributed to over 1,000 subscribers, keeping the ocean-colour user community informed of important events, research activities, training initiatives and mission status news. Furthermore the IOCCG Reports are distributed free of charge to the ocean-colour user community.

6.0 Current IOCCG Membership

The IOCCG Committee consists of members drawn from space agencies as well as the scientific ocean-colour community, and are selected to reflect a balance of both providers and users of ocean-colour data, as well as geographical location. The term of service is usually three years, except for members of the Executive Committee (representatives of sponsoring agencies), whose nomination is governed by a space agency appointments. Rotation of members is being implemented according to a roster (two members marked with an asterisk are new members for 2011). A new Canadian scientific member will also be appointed this year.

IOCCG Committee Members (2010/2011)

Ahn, Yu-Hwan	-	Korea Ocean Research and Development Institute, Korea
Antoine, David (Chairman)	-	Laboratoire de Physique et Chimie Marines, France
Bernard, Stewart*(2 nd Term)	-	University of Cape Town, South Africa
Bonekamp, Hans	-	EUMETSAT, European Union
Bontempi, Paula	-	NASA HQ, USA
Chauhan, Prakash	-	ISRO, India
Crevier, Yves	-	Canadian Space Agency, Canada
DiGiacomo, Paul	-	NOAA, USA
Doerffer, Roland	-	GKSS, Germany
Dowell, Mark	-	JRC, Italy
Dutkiewicz, Stephanie	-	MIT, USA
Greb, Steven	-	Wisconsin Department of Natural Resources, USA
Ishizaka, Joji	-	Nagoya University, Japan
Kampel, Milton	-	INPE, Brazil
Lambin, Juliette*	-	CNES, France
Mao, Zhihua	-	Second Institute of Oceanography, China
Murakami, Hiroshi	-	JAXA EORC, Japan
Pozdnyakov, Dmitry	-	NIERSC, Russia
Regner, Peter	-	ESA/ESRIN, Italy
Sathyendranath, Shubha	-	NCEO Representative, UK
Tanaka, Tasuku	-	Yamaguchi University, Japan
Weeks, Scarla	-	University of Queensland, Australia
Yoder, James (Past-Chair)	-	Woods Hole Oceanographic Institution, USA

7.0 List of IOCCG Sponsors

Activities of the IOCCG are supported by contributions from various national space agencies as well as other organisations listed below, and upon infrastructure support from SCOR. Representatives from these funding agencies are members of the Executive Committee.

- CNES (Centre National d'Etudes Spatiales, France)
- CSA (Canadian Space Agency)
- DFO (Department of Fisheries and Oceans, Canada)
- ESA (European Space Agency)
- GKSS (Germany)
- INPE (National Institute for Space Research, Brazil)
- ISRO (Indian Space Research Organisation)
- JRC (Joint Research Centre, EC)
- KORDI (Korean Oceanographic Research Institute)
- NASA (National Aeronautics Space Administration)
- NCEO (National Centre for Earth Observation, UK)
- NOAA (National Oceanic and Atmospheric Administration)
- SIO (Second Institute of Oceanography, China)

The Bedford Institute of Oceanography (DFO, Canada) provides in-kind support (office space, computer, informatics support, fax, phone and postage). SCOR provides logistic support and manages the NASA funds.

7.4 Other Organizations

7.4.1 Arctic Ocean Sciences Board

Fennel

7.4.2 Partnership for Observation of the Global Oceans (POGO)

Fennel

AOSB: Marine Working Group 5 Year Strategy (2011-2016)

For current information on meetings and activities, please visit our website at:
<http://iasc.arcticportal.org/index.php/home/groups/working-groups/marineaoseb>

Background

The Arctic Ocean Sciences Board (AOSB): the Marine Working Group of the International Arctic Science Committee (IASC) is a non-governmental body that includes members and participants from research and governmental institutions in all 19 IASC countries. It was established in May 1984 to fill a recognized need to coordinate the priorities and programs of countries and institutions engaged in research in the Arctic Ocean. It has been active with programs like the International Arctic Polynya Program, the Greenland Seas project and the development of the Freshwater Budget of the Arctic Report since that time. (See Appendix for a partial list of AOSB projects). The long-term mission of the AOSB is to facilitate Arctic Ocean research through the support of multinational and multidisciplinary natural science and engineering programs.

In 2009, AOSB merged with the International Arctic Science Committee (IASC) as part of IASC's restructuring. The merger was designed to build synergy between the two organizations and to ensure seamless integration of the terrestrial, cryospheric, social, oceanic and atmospheric sciences in the Arctic. This merger opened up opportunities for AOSB that were not present when AOSB was an independent organization. AOSB now has a long-term and secure source of consistent funding allowing it to plan and implement long-term scientific activities. Also, as part of an organization which promotes scientific collaboration across all disciplines in the Arctic, the AOSB: MWG now has opportunities to engage in interdisciplinary work with other working groups within IASC.

Several other factors make this an opportune time to consider AOSB: MWG's strategy over the next several years. As the community enters the legacy phase of the IPY, the AOSB: MWG needs to consider how best to take advantage of the large data cache created during the IPY and consider what observations would best be maintained over the legacy phase. Climatically driven change in the Arctic also creates new issues which the marine working group should consider.

AOSB: MWG Mission

The mission of AOSB: MWG is to encourage, promote and support science-led international programs in the Arctic Ocean and the Subarctic Seas, by offering opportunities for planning and coordination and by facilitating communication and access to facilities. The AOSB: MWG provides a forum to identify key research areas and establish science projects through the national and international initiatives to help fill critical knowledge gaps. The AOSB: MWG considers the exchange and dissemination of data and information as having the utmost importance and encourages its members to adhere to an open data policy. AOSB: MWG works to initiate and maintain observational systems and the data they produce and coordinate with other long-term observational programs in the Arctic and globally. The scientific scope of

the marine working group includes but is not limited to any marine natural science or engineering research in the Arctic Ocean and sub-arctic seas.

Strategic Plan

The ASOB: MWG has identified the following priority themes for 2011-2015:

- Arctic Ocean System: predicting and understanding rapid changes in the Arctic
- Sea ice structure dynamics and the Arctic system
- Ecosystem responses to changing physical parameters in the Arctic
- Understanding geochemical process in the Arctic Ocean and Sub-Arctic Seas
- Improving access to the paleo record of the Arctic Ocean

Due to the overall systems approach to understanding the various time and space scales of the Arctic ecosystem, components of all the themes have some overlapping characteristics. Both interdisciplinary and international efforts are essential to evaluate and forecast key processes in a pan-Arctic and time variable mode in a system poised to continue to change and/or move to a new state. Both national and international science efforts will need to cross-fertilize these thematic goals to undertake truly integrative research.

The Arctic Ocean System: Predicting and Understanding Rapid Changes to the Arctic Ocean System

There is widespread agreement that the Arctic Ocean is now in a state of rapid transition with potentially tremendous environmental, social and economic consequences. This transition is best exemplified by the marked reduction in sea-ice cover and thickness witnessed in instrumental records over the last 30 years. Increased freshwater run-off from rivers and melting glaciers adds to the change of the water mass structures of the Arctic Ocean, and the coastal regions. The Arctic Ocean has, over geological time scales, witnessed a span of climatic conditions, and it is important to use paleo-records to identify linkages between climate and biological or biochemical responses in previous times. Scientific knowledge of the past and present status of the Arctic Ocean combined with process-based understanding of the mechanisms of change and responses in the physical and biological systems is required to make useful projections of future conditions throughout the Arctic region. Such projections are urgently needed to plan for the consequences of climate change. For example, understanding the feedbacks between physical and biogeochemical components of the Arctic Ocean are extremely important not only for the Arctic environment but for the global community as well. Responses in the physical environment and ecosystem functions and structure will affect biodiversity and harvestable resources with impact on the society. The AOSB: MWG intends to play a leading role to further our understanding of this complex system.

In this field, the AOSB; MWG will support the Arctic in Rapid Transitions (ART) initiative which is an international and interdisciplinary science program for the Arctic Ocean integrating the past, present and future. The intent of ART is to study changes and feedbacks among the physical and biogeochemical components of the Arctic Ocean and their ultimate impacts on biological productivity. This includes learning from transitions in the past, understanding present changes and processes, and modeling future

scenarios. The AOSB: MWG will work closely with the Cryospheric, Terrestrial, and Atmospheric WGs of IASC to implement the ART initiative.

Sea Ice Structure Dynamics and the Arctic System

For over ten years AOSB has been active in promoting a better understanding of the relationship between the Arctic and Subarctic seas; first with the Arctic-Subarctic Ocean Fluxes (ASOF) project and then with the integrated Arctic Ocean Observing System (iAOOS) during the International Polar Year 2007-09. The Board will continue to build on this legacy of projects undertaken to provide a better understanding of the physical processes in the Arctic Ocean and Subarctic seas.

The IPY provided a wealth of extensive and intensive observations of the Arctic Ocean, of its hydrography, circulation and interaction with other parts of the Earth climate system. The significant increase in funding during the IPY, the large increase in observations, and the interconnectivity of many of the programs has led to a wealth of new knowledge. During the IPY, AOSB undertook to design the integrated Arctic Ocean Observing System (iAOOS). This effort was concluded in 2011 by extending the iAOOS reports to also include the IPY “legacy phase.” There is a strong belief within the AOSB: MWG that the post IPY period provides the ideal time to ensure that the data collected so far are well mined and new findings made available.

The ice cover in the Arctic Ocean has been in a steady decline over the last thirty years both in extent and in thickness (age). This general trend has been reasonably well modeled but events like the huge reduction observed in September 2007 showed that the physical processes controlling the formation and maintenance of the Arctic Ocean ice cover are still far from understood. Since a drastic reduction, and perhaps disappearance, of the ice cover are likely to trigger the most profound short-term changes in the Arctic, a study of the Arctic Ocean ice cover is a high priority. Such study should include physical processes such as the radiation balance, atmospheric transport of heat and water vapour, air-ice-ocean exchanges and the circulation and overturning of the ocean, and extend from biogeochemical processes, biological production and ecosystems to the living condition of the local residents and the effects on and of human activities such as fishing, oil exploration, transports and tourism.

Among the topics to explore are: The effects of the coupling between the atmospheric transports of heat and water vapour and the radiation balance on the heat exchange between ocean, ice, atmosphere and space, and the interactions between sea ice and the underlying ocean, including the contribution of sea ice to exchanges of heat and freshwater with adjacent oceans. An increased water vapour content could reduce the outgoing long wave radiation and weaken the sea ice formation. The basal melting observed in autumn 2007 indicated that the oceanic heat flux from below is important. Is that heat advected to the Arctic Ocean from the south, or is it supplied locally by the shortwave radiation penetrating into the upper layers of the water column? How important is the detailed physics of the freezing-melting processes? Sea ice does not melt in water with temperatures below 0°C, it dissolves. Water temperatures above 0°C can then drastically increase the basal melting. How important is ridge formation for the creation of new ice and for the survival of old multi-year ice? Will there be a reduction in the deep water formation because of lower salinity on the shelves, ultimately affecting the thermohaline overturning circulation? All these are unsettled questions and they require the joint effort of several different disciplines to entangle the coupling between forcing, response and feedback.

In approaching these tasks the AOSB: MWG will be working with various other organizations, such as CliC, ASOF, and WCRP to determine these yet unanswered critical questions as they relate to the physical processes in the Arctic and try to design a realistic observational program to address these questions. The AOSB: MWG will work closely with the Cryospheric and Atmospheric Working Groups of IASC on these initiatives.

Understanding Biological and Ecosystem Processes in the Arctic and Sub-Arctic Seas

Many areas of the Arctic and sub-arctic seas are experiencing rapid changes in environmental parameters and climate. These changes are causing modifications in the biological and ecological system at various time and space scales. Some species are responding to changing environments through northward migrations from sub-arctic to arctic seas as well as through changes in their interactions both with the physical world and other organisms. These changes in interactions can have potential cascading impacts throughout the total ecosystem. It is essential to evaluate the status and trends of various biological components and processes and their interconnectivity to the physical and chemical components in the Arctic marine system in order to understand the vulnerability and resilience of the ecosystem to climate forcing.

Although recent major changes in the physical domain of the Arctic are well documented, such as extreme retreats of summer sea ice since 2007 and regions of increased seawater temperatures, large uncertainties remain regarding ongoing and future responses in the biological domain. Reduction in sea ice extent in the Arctic ranges from earlier sea ice retreat in the spring/early summer in some areas to a systematic delay in sea ice formation in late autumn. Although modeling using satellite data and some limited field data indicate a potential increase in ocean primary production with sea ice loss, other field data and theory suggest nutrient and light limitations as well as changes in algal species composition might well reduce overall productivity in some regions of the Arctic. However, clear changes have occurred in the food chain, including shifts in species ranges for phyto- and zoo-plankton, benthos, and fish, and loss of sea ice as habitat and platform for marine mammal species.

Key biological processes necessary to track in the marine system include studies of status and change in biodiversity, biologically-mediated processes impacting the marine carbon cycling (e.g., microbial processing, change in faunal growth rates, acidification impacts on biological life cycles, evaluation of the impacts of species moving north with temperature warming, and predator-prey interactions) are a few examples. Interdisciplinary, biologically-oriented studies at various time and space scales in a systems approach are priority for understanding and forecasting the pivotal processes in the ecosystem that both allow it to function and may be the vulnerable links that are necessary to forecast ecosystem response.

The AOSB: MWG intends to play a role in increasing our understanding of the ongoing and potential impacts of biological processes and ecosystem changes under further loss of sea ice through supporting multiple scales of studies on biological processes and development of biologically oriented time series observations programs in the Arctic. In this vein, the AOSB: MWG supports the continued development of a Distributed Biological Observatory (DBO). The DBO is designed as a change detection array for the identification and consistent monitoring of biophysical responses in pivotal geographic areas that exhibit high productivity, biodiversity and rates of change. The Pacific Arctic Group (PAG) in the Pacific sector of the Arctic is undertaking a pilot program of this array. With the goal of the AOSB: MWG to both understand biological processes and ecosystem change in the Arctic, actions should be supported which

help to harmonize DBO activities in the Pacific sector with similar and ongoing planned activities in the Atlantic sector of the Arctic. Additionally, understanding biological processes in an interdisciplinary fashion across multiple time and space scales is a key goal of the ART program, also supported by the MWG: AOSB.

The MWG-AOSB portfolio of supporting studies focused on biological process studies in a multidisciplinary context coincident with development of biologically oriented time-series observations is essential to understanding and forecasting ecosystem change in a rapidly changing Arctic region. The next steps should also establish Pan-Arctic baseline data on Arctic marine food web characteristics, which will require filling major gaps in understudied taxa (e.g. microbes) and regions (deep sea basins) as well as application of new emerging study tools in the Arctic.

Understanding Geochemical Processes in the Arctic Ocean and Sub-Arctic Seas

The observed and predicted changes in the sea ice cover of the Arctic Ocean will likely have major impacts on the fluxes of geochemical constituents as well as on the ventilation of deep waters. High biological productivity will likely remain on the shelf areas and higher biological activity is expected over the deep central basins, specifically in the marginal ice zones that are in, for example the Barents and Bering Seas and are among the most productive areas. However current model assessments differ substantially in the estimated magnitude of the changes of biological productivity. The increased melting of sea ice also has an impact on the surface water through the “release” of geochemical constituents. Increased surface production will likely also increase the export production in the central Arctic that could result in a change of the geochemistry of the deep and bottom waters. With increased influx of organic matter from the upper layers of the ocean, mineralization increases which results in elevated bottom water nutrient concentrations and dissolved carbon and a decrease in oxygen concentration. With less summer sea ice coverage, the winter sea ice production increases, which results in more brine formation that contributes to deep water formation. Such an increase would be seen in elevated concentrations of transient tracers, i.e. CFCs and sulfur hexafluoride.

Thawing of coastal permafrost has increased the supply of terrestrial organic matter, both dissolved and particulate, to the coastal seas. This has had a profound impact on the biogeochemistry in the shelf seas. For instance it was observed during IPY that large parts of the East Siberian shelf seas were oversaturated in CO₂ even in August when primary production was at its peak. Increased CO₂ and sea ice loss together leads to under-saturation of aragonite with implications on shell forming Arctic biota. Furthermore virtually unexplored territories are subsea permafrost regions beneath Arctic shelf seas. Subsea permafrost, such as in the Laptev Sea, was formed under subaerial conditions during the last glacial periods and subsequently underwent submersion due to postglacial sea-level rises. Therefore its present state is highly transient. After submergence, subsea permafrost degrades, thawing from the seabed downwards by the influx of salt and heat as a result of the new oceanographic boundary conditions, even in the presence of negative mean seafloor temperatures. Changes in temperature and salinity distribution within the water column are of major importance as they directly influence the energetic balance of the subsea permafrost. Even though the subsea permafrost is of importance for the global climate system, our knowledge on its distribution, its recent dynamics, and its stability factors as well as its microbial environment and their impact on the regulation of biogeochemical cycles is inadequate. We know that a considerable amount of organic carbon is stored in the upper layer of permafrost and gas hydrates are expected within and beneath the subsea permafrost. During IPY was extremely high concentration of

methane observed in the East Siberian shelf seas, even if no changes in its magnitude could be deduced from the limited historic studies covering the full area of this region. Increasing water temperatures over most of the Arctic shelves are likely to accelerate thawing of subsea permafrost along the Siberian shelf seas in particular. Increased thawing of permafrost could accelerate the release of greenhouse gases, especially methane, into the atmosphere, further elevating global warming.

Standing on the threshold of these unprecedented changes, the AOSB: MWG supports, in collaboration with other international partners, high quality studies of relevant properties of the full water column of the central Arctic Ocean on a regular basis as well as studies from the coast, over the vast continental shelves and across the continental margin (at least every 5 years). Even following the recent IPY, the current data inventory is still low for most regions of the Arctic (except some marginal seas) and future studies should fill gaps in our pan-Arctic data inventory in a coordinated way. Additionally, evaluation of changing sediment geochemistry over the shallow Arctic shelves with potential dramatic consequences through ocean acidification is also of concern.

Improving access to the paleo record of the Arctic Ocean

Paleo-oceanography and paleo-climate studies deepen understanding of the present by revealing how the earth was once different and how it came to be as it is today. In view of the profound changes that are underway in the Arctic Ocean system such as the shrinkage of ice cover, the increase in freshwater inputs, the warming of water masses, and associated changes in circulation and heat balance, it is necessary to evaluate the past changes in the system and the unique feedback mechanisms that operate within the region on a variety of timescales. These tasks require the use of scientific drilling supplemented by enhanced coring techniques and identification of optimal coring sites. For example, the recovery of pre-Quaternary sediments requires sedimentary records significantly longer than those typically collected in the Arctic Ocean, and the Holocene study needs identification of sites with high sedimentation rates to achieve sub-millennial age resolution.

One goal is to examine records of extensive ice cover as well as ice free and warmer than present day conditions to address how these environmental extremes feedback on global climate/ocean dynamics. Short-term climatic events such as the Little Ice Age and the Medieval Warm Period should be related to longer-term arctic variability expressed in glacial-interglacial cycles and events like the Paleocene Eocene Thermal Maximum (PETM) and the Eocene/Oligocene transition. What role did the Arctic play in driving these events in terms of precipitation, river discharge, and freshwater export? What are the possible feedback mechanisms specific to the Arctic that help to regulate things like temperature, heat and moisture transport, and carbon cycling?

During the Arctic Coring Expedition (ACEX) a unique sedimentary record was recovered. These sediments preserve a record from the “Eocene Greenhouse climate” when the earth was at its warmest, before a long interval of gradual cooling, which led to the Pleistocene Ice Ages and then to today’s climate. For much of the Cenozoic, the sediments recovered during ACEX are the first ever seen from this crucial period. Paleo-oceanographic records in the basin, gateways and slope regions preserve the transition from the warm high CO₂ environment that extended to the Paleocene. These records are critical to understanding the consequences of high atmospheric CO₂ and calibrating predictions of the future consequences of accumulating greenhouse gases.

Another component based on scientific drilling is to reconstruct the tectonic history of the Arctic Ocean. The tectonic history of the Arctic Ocean is critical to setting the physical boundary conditions that restrict and enable oceanographic processes, through the opening and closing of the various gateways that shape ocean circulation through the changes in basin size and shape.

All of these objectives will require a sequence of activities, building through successive cruises and studies, to acquire the information necessary to bring these programs to fruition. Site surveys will be necessary to identify critical locations for monitoring and for seafloor sampling by drill. Technological development is required to make the most of limited ship time and spatially restricted monitoring of the ocean, seafloor and ice.

Tools to Support Research

The AOSB: MWG will use several tools at its disposal through IASC to support these strategic goals. The AOSB: MWG will meet annually to discuss ongoing activities and initiate new activities of high importance. Activities supported by the AOSB: MWG may receive funds for workshops or planning meetings or they may receive funding directly through IASC as priority activities. AOSB: MWG may jointly enter into an activity with a partner organization such as ICES, SCOR, CliC, WCRP, or a working group of the Arctic Council. The AOSB: MWG may decide to support a synthesis or publication effort with limited funding. Lastly, the AOSB: MWG may support the development of a network of activities through support of planning workshops.

Partial List of AOSB Activities Completed or Underway

Provided here is a list of AOSB: Marine Working Group activities which have been undertaken by the AOSB. For more information on these activities, please see the AOSB website.

Greenland Seas Project: Aimed at observing and modelling the atmospheric, ice, oceanic and biological processes relevant to understanding the role of the Nordic Seas in the climate system. (Undertaken with ICES).

International Arctic Polynya Program (IAPP): Aimed at observing and understanding the role of polynyas in the arctic marine system. It was undertaken in 1989 with the Northeast Water Polynya project (NEW), followed by the North Water Polynya Project (NOW) and succeeded in 2001 by the Canadian Arctic Shelf Exchange Study (CASES) which incorporated the Cape Bathurst Polynya.

Arctic PAleo River Discharge (APARD) program: Aimed at understanding the impact of river discharge on the Arctic marine system over time. This was followed by the Siberian River Run-off (SIRRO) program.

Arctic Sub-arctic Ocean Fluxes (ASOF): Aimed at observing and understanding the long-term heat exchanges between the Arctic Ocean and adjacent seas.

Shelf-Basin Exchange (SBE) program: Aimed at coordinating national and international shelf-basin exchange studies to better understand the physical dynamics and biological impacts of these exchanges.

Integrated Arctic Ocean Observing System: Aimed at coordinating the many IPY activities to better understand the present state and future fate of the Arctic Ocean perennial sea ice and its impact on the climate system.

New Research Generation (NRG): Aimed at engaging early-career scientists in the research planning process.

Arctic in Rapid Transition (ART): Aimed at observing past and future feedbacks among the physical and biogeochemical components of the Arctic Ocean and their ultimate impacts on biological productivity.



Raising the profile of oceans within the Group on Earth Observations (GEO)

Since GEO was formed, POGO has always regarded it as an organization with which it should cooperate closely. POGO is associated with various marine activities in GEO, such as the Chlorophyll Globally Integrated Network (ChloroGIN) and Societal Applications in Fisheries and Aquaculture using Remotely-sensed Imagery (SAFARI), which have achieved considerable success. But notwithstanding the number of excellent marine projects related to GEO, the collective prominence of oceans within GEO has, until now, been less than we would have preferred.



View of the "Jet d'Eau"
(fountain) on Lake Geneva.

GEO Work Plan 2012-2015

With GEO launching a new Work Plan, POGO saw an opportunity for substantial enhancement of the profile of oceans in GEO by proposing an over-arching Ocean Task to be included in the new Work Plan. An initial proposal was submitted in February 2011 and expanded in April, in preparation for the GEO Work Plan Symposium that took place in Geneva (4-6 May 2011). The meeting was attended by Sophie Seeyave (POGO) Boram Lee (World Meteorological Organisation) and Keith Alverson (Global Ocean Observing System, GOOS), who gave a presentation on the different projects that would be grouped under the new Task. The other participants welcomed the enhanced visibility of the ocean in the new Work Plan and suggested some areas of potential synergy between tasks.

Oceans and Society: the Blue Planet

The proposed Task has now been incorporated into the GEO Workplan (Version 1) as "SB-01 Oceans and Society: the Blue Planet". It includes GOOS, Coastal GOOS, the GOOS Panel for Integrated Coastal Ocean Observations (PICO), OceanSITES, ChloroGIN, SAFARI, the International Ocean-Colour Coordinating Group (IOCCG), the Continuous Plankton Recorder (CPR), the Committee on Earth Observation Satellites (CEOS) Virtual Constellations for the Ocean, the Global Ocean Data Assimilation Experiment (GODAE), WG 5 of GEO BON (Marine), CEOS WG on Climate, Water Quality (freshwater and coastal), the Coastal Zone Community of Practice and POGO capacity-building. An advantage of this arrangement is that it brings together many of the elements of Oceans United (<http://www.oceans-united.org>) to work collectively for an ocean observing system. Although oceans are not usually treated as a societal-benefit area of GEO, the new Task is grouped under "Information for Societal Benefits", implying a public need for ocean observations.

The 2012-2015 Work Plan Version 1 is under official review until 31 August. Based on the outcome of this review, Version 2 will be issued in October with other Plenary documents and submitted to the GEO-VIII Plenary (16-17 Nov 2011, Istanbul) for "acceptance as a living document". We regard the acceptance of this umbrella Task by GEO, the result of considerable lobbying by Oceans United and hard work by the POGO Secretariat, as marking a major step forward in POGO's relations with GEO.

GEO Biodiversity Observation Network

GEO BON is the biodiversity element of GEO. It is structured around a series of working groups of which one (WG5) deals with marine biodiversity. Since WG5 was formed, it has been co-chaired by Jan de Leeuw and Carlo Heip. Jan has now stepped down due to other duties, so a new co-chair is being sought. The GEO BON scientific steering committee met recently in Geneva. POGO was represented by Trevor Platt. The committee consists mostly of terrestrial specialists. One of the current activities of the committee is to develop a set of Essential Biodiversity Variables (by analogy with the Essential Climate Variables already in use in the climate community). This is a challenging task that will require a great deal of work before a satisfactory solution is found. The EU is to issue a major funding call for work in support of GEO BON.

Other POGO News



New POGO Administrative Assistant

The POGO Secretariat is pleased to announce the addition of a new member to the team. Laura Ruffoni joined the Secretariat on a temporary basis at the end of May, and her position was made permanent on 4th July. Laura has a BA in Law from the University of Bergamo, Italy. She can be contacted at laru@pml.ac.uk or on pogoadmin@pml.ac.uk.

Institute for Marine and Antarctic Studies (IMAS) joins POGO

IMAS was created by the University of Tasmania Council in February 2009 to bring together the many strands of marine and Antarctic research currently being pursued in and around Hobart, to encourage the development of strengthened research links and exploit new research opportunities. IMAS is both a teaching and research organisation, with research covering a wide range of topics (see <http://www.imas.utas.edu.au/about-imas>). IMAS works in close partnership with other organisations such as the Integrated Marine Observing System (IMOS), with which it will soon be co-located. The IMAS representative to POGO is the Executive Director, Prof. Mike Coffin. POGO would like to extend a warm welcome to its newest member and looks forward to further collaboration.

POGO at Expo 2012 Yeosu Korea

Planning is underway for the POGO exhibit at the 2012 Expo in Yeosu, Korea, under the theme "The Living Ocean and Coast". Following meetings with the Expo designers in May and June, the conceptual design of the exhibit has been agreed. This will be developed around the themes: (1) Ocean observations: "How have we been observing the ocean over the last century?"; (2) POGO member institutions: "Who is carrying out these observations?", including information about flagship projects of the member institutions; (3) Experiencing the ocean through the five human senses -interactive displays to demonstrate how the ocean looks/sounds/feels/smells/tastes. If you would like to contribute, please e-mail Sophie Seeyave at ssve@pml.ac.uk.



EXPO 2012
YEOSU KOREA

POGO is also part of the Yeosu Declaration International Review Committee (IRC) and Sophie Seeyave participated in the IRC meeting in Seoul on 11 May 2011 where the first draft of the Declaration was reviewed.

IOC XXVI Assembly, June 2011

The IOC Assembly was convened in June at UNESCO (Paris), where POGO was represented by Trevor Platt. One of the main items of business of interest to POGO was restructuring the governance of GOOS. Considerable time was spent on drafting a suitable resolution for consideration by the Assembly. Generally, member states of the IOC were enthusiastic about the proposed new structure. Another relevant agenda item was a report by John Gunn on behalf of the committee established after OceanObs' 09 (Venice) to discuss the way ahead for ocean observations. The vision of this group is based on a set of Essential Ocean Variables, which have yet to be defined. A major emphasis of the report is the extension of observing systems to include biological and biogeochemical observations. The Working Group has produced a draft Framework for Ocean Observing, which is under public consultation until 29 July.

SCOR-POGO International Quiet Ocean Experiment Open Science Meeting

SCOR and POGO are convening an open science meeting for an International Quiet Ocean Experiment (IQOE) at IOC-UNESCO in Paris, from 30 August to 1 September 2011. The deadline for early registration is 31 July. The purpose of the open science meeting is to develop a Science Plan for the IQOE, a focused international research effort that may last a decade or so. In preparation for the meeting, an article on the IQOE was published in *Oceanography* (Boyd et al., 2011: http://www.tos.org/oceanography/archive/24-2_boyd_il.html). Registration, programme and logistical information on the OSM can be found at: <http://www.iqoe-2011.org>.

Update on POGO Capacity Building

POGO Visiting Professorships

Last year's Visiting Professorships were awarded to Profs. Lisa Levin and David Checkley, both from Scripps Institution of Oceanography, who spent 6 months (Jan-June 2011) of sabbatical leave teaching and mentoring at the National Marine Information and Research Centre (NatMIRC).

They spent an intensive seven days with 37 UNAM Biology and Fisheries students in March. They lectured at the University of Namibia in Windhoek on general marine ecology, bioinvasions, ocean observing, and climate change and fisheries. The students were taken to the Henties Bay marine facility where they sampled four salt ponds, reflecting a salinity gradient from 35 to 200 ppt. Measurements, collections, and observations included water and sediment properties, planktonic and benthic algae and invertebrates, and birds.

The collections provided material for lab work over the next two days and assignments emphasized pond characterizations (species composition, abundance diversity) and ecosystem-level processes. Group presentations were given and discussions were held by the students. Additional activities at Henties Bay included two lectures on climate change (covering deoxygenation, acidification, natural and anthropogenic fisheries variations) and a rocky shore field trip to illustrate concepts given in lecture in Windhoek.



Prof. Levin and UNAM students on the rocky shore in Solitude (central Namibia).

During their stay, they spent a lot of time mentoring students and scientists, including their hosts, Drs.



Prof. Levin teaching at the Henties Bay field station.

Bronwen Currie and Anja Kreiner. This included advice on benthic survey/sampling design, sampling methods, isotope analyses and species identification, advice on the Continuous Underway Fish Egg Sampler (CUFES) and discussion of Northern Benguela ecosystems and fisheries.

They also established a Friday afternoon lecture series at NatMIRC. During the regular Friday seminars, all interested staff members (typically 15-20) were invited and joined discussions on several aspects of the pelagic system in the Northern Benguela. These seminars were very popular and provided an excellent opportunity at NatMIRC to exchange ideas on a regular basis. They also spent one week at the University of Cape Town (UCT), hosted by Prof. Coleen Moloney. They taught, lectured, and interacted with students and staff in the Departments of Zoology and Oceanography.

"Prof. Checkley showed great interest and understanding for the challenges faced at NatMIRC," commented Dr. Anja Kreiner. "I consider ourselves very fortunate that he spent six months at our institute and I am sure that many of the ideas sparked through discussions with him will be taken further and contribute to a better understanding of our marine system and improved management of our fisheries."

The next year's Visiting Professors have now been selected. Prof. Walker Smith (Virginia Institute of Marine Science, USA) will be visiting Lam Ngoc Nguyen at the Institute of Oceanography in Nha Trang, Vietnam, for 4 weeks in March 2012. Training will be on the use of fluorescence in oceanographic studies of coastal waters of Vietnam.

Third Nippon Foundation-POGO Centre of Excellence Graduation

The following article was contributed by Emily Greenhalgh, Bermuda Institute of Ocean Sciences.

The third class of POGOian graduates headed home at the end of May and the year 4 trainees will arrive at the Bermuda Institute of Ocean Sciences (BIOS) later this summer. The NF-POGO Centre of Excellence in Ocean Observations (CofE) at BIOS is a 10-month program designed to educate and expand observational oceanography around the world by offering training and experience to scientists from developing countries.

Every year, the CofE receives roughly 100 applications for the 10 available slots. The potential candidates go through a rigorous vetting process by BIOS faculty and POGO Secretariat staff. To expand the reach of the program, the CofE chooses scientists from all over the world. In addition, the CofE tries to split the NF-POGO slots equally between genders. This year, the trainees hailed from the Ivory Coast, Russia, Turkey, Venezuela, Brazil, Ecuador, India, Iran, Tunisia, and Vietnam.

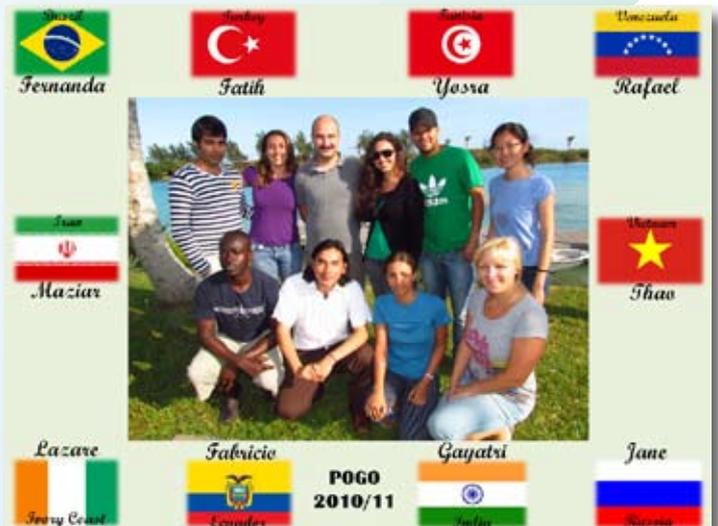
Other goals of the program are to grow human resources in developing countries, expand international networking in ocean sciences, and strengthen relations between developed and developing countries. "Ideal candidates already hold a position at an academic institution in their home country, furthering potential opportunities for training and scientific exchange with POGO member institutions around the world", said BIOS Education Director Dr. Gerry Plumley.

The program itself is rigorous; the 10 POGOians spend their months working closely with some of the best scientists in the field. POGO scholars not only attend lectures and workshops given by BIOS faculty and visiting scientists, they also gain hands-on experience in the lab and at sea. Bermuda, or more specifically the Sargasso Sea, is home to the longest running ocean time-series study in the world and the POGO scholars spend time training at sea on BIOS's research vessel, the 168-foot Atlantic Explorer, and using state-of-the-art instrumentation.

Each POGO scholar focuses a great deal of effort on an independent research project supervised by a member of the faculty or by POGO members. These projects focus on a number of different research themes that are important at BIOS, ranging from phytoplankton growth in the Sargasso Sea to the oceanic/atmospheric carbon cycle. Vietnamese POGOian, Thao Pham, worked

with Dr. Nicholas Bates on her project: "Interannual to Decadal Variability of Upper Ocean Carbon Cycle in the Western North Atlantic Ocean." She collected data from two long-term sampling sites, Hydrostation S and the Bermuda Atlantic Time-series Study (BATS), concerning temperature, salinity, dissolved inorganic carbon, total alkalinity and other germane parameters. "The most exciting thing I learned here is an understanding of the response of the ocean carbon cycle to climate change," said Thao. "I hope that I can continue this research in the South China Sea when I go back to Vietnam and continue my job at the Institute of Oceanography."

"These 10 months have been a continuous cycle of learning, experiencing and enjoying the science as well as different cultures which has changed my perspective about a lot of things," said 2011 POGO graduate, Gayatri Dudeja from India. When asked about the POGO program, nearly all of the students mentioned learning about different cultures among the most unique aspects. By transplanting international scientists to Bermuda, the CofE at BIOS fosters global cooperation and cultural understanding in a new way.



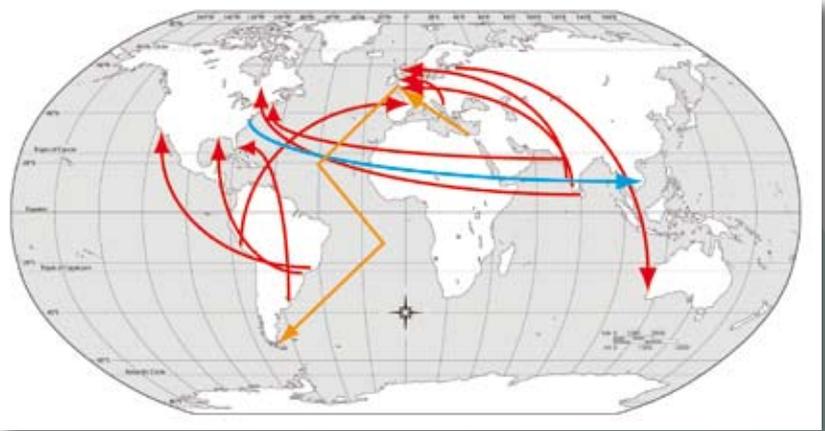
The Year 3 "POGOians" having recently graduated from the NF-POGO Centre of Excellence.

Fatih Sert, from Turkey, said that he planned to go back to his country and continue his PhD, while staying connected with the other POGOians. "I am hoping to keep in touch with all the people I met here. Hopefully it will be possible to design a collaborative research program with scientists from different parts of the world."

"With collaborations like these, it is expected that the legacy of the course will endure far into the future," added Plumley.

POGO-SCOR Visiting Fellowships

Out of 37 applications received, ten POGO-SCOR Visiting Fellowships were awarded for 2011. The successful applicants were selected on the basis of the quality of their application, relevance of the proposed training to POGO and SCOR, and demonstration that it will lead to sustained capacity building at the host institute. The selection committee also had to strive to achieve regional balance in the final selection. The awardees are from Argentina, Brazil, Croatia, Estonia, India, Peru and Sri Lanka. The host institutions include Australia, USA, UK and France.



Map showing the origins and destinations of the 2011 POGO-SCOR Visiting Fellowships (red arrows), the POGO-AMT Visiting Fellowship (orange arrow) and the POGO Visiting Professorship (blue arrow).

POGO-AMT Fellowship

This year's POGO-AMT fellow is Dr. Alaa Younes, from the National Institute of Oceanography and Fisheries (NIOF) in Alexandria, Egypt. He will be working with Dr. Gavin Tilstone, from Plymouth Marine Laboratory, on the effect of CO₂ enrichment on plankton community structure, photosynthesis and primary production in the Atlantic Ocean. He will arrive at PML at the end of August to receive training prior to the cruise, then embark on RRS Discovery on 29 September with the rest of the AMT scientific party. The 6-week cruise will start in Avonmouth (UK) and end in Punta Arenas, at the southern tip of Chile. Dr. Younes will then spend a further 4 weeks at PML carrying out some post-cruise analyses.

NF-POGO Alumni Network for Oceans (NANO)

The Nippon Foundation has generously funded POGO Capacity Building programmes since 2004. These included at first the Visiting Professorships, which took place in India, Fiji, Sri Lanka, Brazil, Tunisia and Vietnam between 2004 and 2007. This programme was then superseded by the the Centre of Excellence in Ocean Observations in Bermuda, which is about to begin its fourth year. NF-POGO initiatives have trained some 180 scientists.

Creating a network of alumni has been part of the Nippon Foundation's vision for several years and this is now beginning to take shape. Since the exploratory meeting in October 2010, two fellowships have been awarded to NF-POGO alumni to start building the network. This has consisted of contacting all the former scholars of the aforementioned programmes, collecting information on their career progression and entering it into a database. A website was then developed (<http://www.nf-pogo-alumni.org>), including alumni contact details, research interests and publications (accessible only to the alumni), information on on-line oceanographic datasets and a survey to gather information on the data currently being collected by the alumni themselves.

The aim is to use this information to prepare proposals for joint projects to be conducted by the alumni. These proposals will be drafted during a Network Meeting in Abingdon (UK), from 26 to 28 September 2011. They will then be submitted to the Nippon Foundation in the hope of obtaining additional funding for these projects in 2012. Prior to this meeting, the alumni will be asked to provide outlines of joint projects that they would be interested in and able to contribute to. There will also be a regular NANO newsletter, including articles written by the alumni and by other NANO-affiliated scientists.

Ocean Summer Schools website

The International Oceanographic Data and Information Exchange (IODE) of IOC has set up an Ocean Summer Schools site as a service to the global ocean science community. This Website is co-sponsored by IODE/IOC, SCOR, POGO, and the North Pacific Marine Sciences Organization (PICES). The website can be accessed at <http://www.oceansummerschools.org>.

News from POGO Members

Plymouth Marine Laboratory (PML)

The following article was contributed by Kelvin Boot, Plymouth Marine Laboratory, UK.

PML continues in its interdisciplinary approach to contributing to an understanding of the world's oceans, through ongoing projects and new collaborations. Ocean acidification has become an area of research where PML has developed a broad expertise. Within the UK Ocean Acidification Research Programme, PML is leading a number of work packages dealing with impacts on benthic organisms under different pH and temperature scenarios. A second work package relates to projecting any impacts into the future through modelling, whilst PML also has responsibility for Knowledge Exchange for the whole programme. One output has been a short film 'Ocean acidification: Connecting science, industry, policy and public' (http://www.youtube.com/watch?v=_BPS8ctVW2s), which deals with the need for clear communication between the various stakeholder groups.

In recognition of PML's skills in Earth Observation (EO) it has become the coordinator for EAMNet which aims to construct a network linking EO information providers, user networks and centres of excellence in Europe and Africa in the area of coastal and marine observations towards sustainable development in Africa. The network will undertake capacity building and maintenance and build upon existing infrastructure and expertise in Africa. The overall aim is to improve the exploitation of EO data for coastal and oceanic monitoring towards an Africa-wide observation system (GOOS-Africa). The University of Cape Town (POGO member) is also a partner.

Marine Ecosystem Evolution in a Changing Environment (MEECE), a European FP7, in its third of a four year project is also coordinated from PML. It uses predictive models to explore the impacts of both climate drivers (acidification, light, circulation and temperature) and human induced drivers (fishing, pollution, invasive species and eutrophication) on marine ecosystems. Many of PML's other research areas including long-term data collection through the Western Channel Observatory, are of global significance, contributing to the wider knowledge necessary to understand and manage our seas into the future.

Indian National Centre for Ocean Information Services (INCOIS)

Scientists from INCOIS in Hyderabad, India and the Centre for Earth Science Studies are working on a programme to establish an ocean forecast system that will provide the district-level administration in the State with early warning and information on natural hazards such as storm surges, cyclones, tidal waves, and tsunamis. The system will rely on a network of wave rider buoys and shore stations, supplemented by satellite data. While the first wave buoy off the coast of Valiathura in Thiruvananthapuram has become functional, the second one is to be established in Kozhikode this year. The buoys will generate real time information on waves, tides, ocean currents, and sea surface temperature. This information is relayed to a supercomputer at INCOIS and incorporated with satellite data to generate site-specific models for forecasting. The forecast will be disseminated to the fishing community through a website and electronic display boards along the coastal belt. Efforts are on to rope in mobile service providers to provide SMS alerts. To read the full article go to <http://ocean-partners.org/products/media/785-ocean-forecast-system-under-development-in-india>.

13th POGO Annual Meeting

The next POGO Annual Meeting will be hosted by the University of Hawaii, from 9 to 11 January 2012 (see <http://ocean-partners.org/meetings-and-workshops/meetings-and-workshops/776-pogo-13>). The POGO Secretariat is now calling for suggestions of agenda themes and items. It was decided at the last POGO meeting that the agenda would be more focussed on strategic issues of international relevance.

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